**3GPP TSG-RAN4 Meeting # 112 *R4-2413084***

**Maastricht, Netherlands, 19th – 23rd August, 2024**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
|  |
|  | **38.133** | **CR** | **4894** | **rev** |  | **Current version:** | **18.6.0** |  |
|  |
| *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:***  | CR on R18 ATG measurement |
|  |  |
| ***Source to WG:*** | ZTE Corporation, Sanechips |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | [NR\_ATG-Core] |  | ***Date:*** | 2024-08-09 |
|  |  |  |  |  |
| ***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)* |
|  |  |
| ***Reason for change:*** | There are some incorrect description or missing in 38.133 regarding ATG measurement, we refine these description.  |
|  |  |
| ***Summary of change:*** | In details, including the following five changes:Change #1: This existing clarification regarding the MO statistics is missing in ATG.Change 2: Regarding the number of frequency layer, “layer” is missing. Long periodicity measurement case does not exist in ATG, no need to mention.Change3: Only traditional gap is mentioned by ATG, not touch new type of gap such as NCSG, so we remove the redundant.Change 4&5: To align the description on the assumption of antenna array. Furthermore, here it mentions the case of antenna array configured instead of the relevant UE capability. |
|  |  |
| ***Consequences if not approved:*** | Not incorrect and not accurate |
|  |  |
| ***Clauses affected:*** | 9.1D.5.2.2, 9.2D.1, 9.2D.5.1, 9.3D.9.1  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS 38.533 |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

# ~~<Start of Change #1>~~

#### ~~9.1D.5.2 Monitoring of multiple layers within gaps~~

~~The carrier-specific scaling factor CSSF~~~~within\_gap,i~~ ~~for a measurement object~~ *~~i~~* ~~derived in this chapter is applied to following measurement types:~~

~~- SSB-based intra-frequency measurement object with no measurement gap in clause 9.2D.5, when all of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.~~

~~- SSB-based intra-frequency measurement object with measurement gap in clause 9.2D.6.~~

~~- CSI-RS based inter-frequency measurement in clause 9.10D.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are overlapped by the measurement gap.~~

~~- CSI-RS based inter-frequency measurement in clause 9.10D.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are partially overlapped by the measurement gap.~~

~~- SSB-based inter-frequency measurement object with measurement gap in clause 9.3D.4.~~

~~- SSB-based inter-frequency measurement object without measurement gap for UE capable of~~ *~~interFrequencyMeas-NoGap~~* ~~in clause 9.3D.9, when~~

~~- all of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, or~~

~~- part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, but the flag~~ *~~interFrequencyConfig-NoGap-r16~~* ~~is not configured by the Network.~~

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

~~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, CSSF~~~~within\_gap,i~~ ~~and requirements derived from CSSF~~~~outside\_gap,i~~ ~~are not specified.~~

~~Number of SSB layers shall include SSB for mobility and that as associated SSB for CSI-RS mobility. the ssbfrequency is counted only once if the ssbfrequency for mobility and associated SSB are the same, or ssbfrequency and smtc in multiple MOs are the same.~~

~~SSB-based measurement and CSI-RS based measurement for mobility configured in the same measurement object are considered as different layers.~~

# ~~<End of Change #1>~~

# <Start of Change #2>

##### 9.1D.5.2.2 SA mode: carrier-specific scaling factor for SSB, CSI-RS-based L3 measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For each measurement gap *j*, count the total number of intra-frequency measurement objects and inter-frequency measurement objects on all frequency layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- For UEs which are configured with per UE gaps the counting is done on a per UE basis.

- Mintra,i,j: Number of intra-frequency measurement objects, including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter,i,j : Number of NR inter-frequency layers including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Minter,i,j equals 0.

- Mtot,i,j = Mintra,i,j + Minter,i,j : Total number of intra-frequency, inter-frequency layers, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

The carrier specific scaling factor CSSFwithin\_gap,i is given by:

 If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

 If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×Mintra,i,j) in gaps where Minter,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Mintra,i,j) in gaps where Minter,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an inter-frequency measurement object on any one frequency layer, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×Minter,i,j) in gaps where Mintra,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Minter,i,j)in gaps where Mintra,i,j=0, where *j*=0…(160/MGRP)-1

Where Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate ~~and not used for a long-periodicity measurement defined above~~.

# <End of Change #2>

# <Start of Change #3>

## 9.2D NR intra-frequency measurements for ATG

### 9.2D.1 Introduction

A measurement is defined as a SSB based intra-frequency measurement provided the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same.

The UE shall be able to identify new intra-frequency cells and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified intra-frequency cells if carrier frequency information is provided by PCell, even if no explicit neighbour list with physical layer cell identities is provided.

The UE can perform intra-frequency SSB based measurements without measurement gaps ~~(either legacy measurement gap)~~ if

- the UE indicates ‘no-gap’ via *intraFreq-needForGap* for intra-frequency measurement, or

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

- the active downlink BWP is initial BWP[3].

For intra-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.2D.5.3. SSB based measurements are configured along with one or two measurement timing configuration(s) (SMTC(s)) which provides periodicity, duration and offset information on a window of up to 5ms where the measurements are to be performed. For intra-frequency connected mode measurements, up to two measurement window periodicities may be configured. A single measurement window offset and measurement duration are configured per intra-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB and measure RSSI of RSRQ which start earlier than the gap starting time + switching time, nor detect SSB and measure RSSI of RSRQ which end later than the gap end – switching time. Switching time is 0.5ms for frequency range FR1.

The requirements in this clause shall also apply, when the UE is configured to perform SRS carrier based switching and using measurement gaps.

# <End of Change #3>

# <Start of Change #4>

### 9.2D.5 Intra-frequency measurements without measurement gaps

#### 9.2D.5.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra-frequency cell within Tidentify\_intra\_without\_index if the UE is not indicated to report SSB based RRM measurement result with the associated SSB index(*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE is indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index.

 Tidentify\_intra\_without\_index = (TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra) ms

 Tidentify\_intra\_with\_index = (TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra + TSSB\_time\_index\_intra) ms

Where:

 TPSS/SSS\_sync\_intra: it is the time period used in PSS/SSS detection given in table 9.2D.5.1-1.

 TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2D.5.1-3.

 T SSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2D.5.2-1.

 CSSFintra: it is a carrier specific scaling factor and is determined according to CSSFoutside\_gap,i in clause 9.1D.5.1 for measurement conducted outside measurement gaps, i.e. when intra-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps, or according to CSSFwithin\_gap,i in clause 9.1D.5.2 for measurement conducted within measurement gaps, i.e. when intra-frequency SMTC is fully overlapping with measurement gaps.

 For a UE that supports Pre-MG, an SMTC occasion is only considered to be overlapped by Pre-MG if the Pre-MG is activated.

 If the high layer in TS 38.331 [2] signalling of *smtc2* is configured, the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc2*; Otherwise the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

When UE supports *concurrentMeasGap-r17* and is configured with concurrent measurement gaps,

 Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps. Kp = Ntotal / Navailable, where Navailable and Ntotal are calculated as follows:

- For a window W of duration max(SMTC period, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gap, and starting from the beginning of any SMTC occasion:

- Ntotal is the total number of SMTC occasions within the window, including those overlapped with measurement gap occasions within the window, and

- Navailable is the number of SMTC occasions that are not overlapped with any non-dropped MG occasion within the window W, after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1.8.3.

 Kp = 1 when Navailable = 0.

- Otherwise, when UE is not configured with or UE does not support concurrent measurement gaps:

 When intra-frequency SMTC is fully non overlapping with measurement gaps or NCSG, or intra-frequency SMTC is fully overlapping with MGs or NCSG, Kp=1

 When intra-frequency SMTC is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP. When intra-frequency SMTC is partially overlapping with NCSG, Kp = 1/(1- (SMTC period /VIRP)), where SMTC period < VIRP. For calculation of Kp, if the high layer signalling (TS 38.331 [2]) of *smtc2* is configured, for cells indicated in the *pci-List* parameter in *smtc2*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc1.* If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index

For UE with the antenna array,

Klayer1\_measurement=1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting outside measurement gap are not fully overlapped by intra-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting outside measurement gap and fully-overlapped by intra-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, where SSB symbols are indicated by the union set of *SSB-ToMeasure* from all the configured measurement objects on the same serving carrier which can be merged.and RSSI symbols are indicated by *SS-RSSI-Measurement*;

Klayer1\_measurement=1.5, otherwise.

If the above-mentioned reference signal configured for L1-RSRP measurement is aperiodic CSI-RS resource, longer cell identification delay would be expected.

Otherwise, Klayer1\_measurement=1.

Table 9.2D.5.1-1: Time period for PSS/SSS detection, (Frequency range FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max( 600ms, ceil(5 x Kp x N1Note 3 x Klayer1\_measurement) x SMTC period )Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5 x 5 x Kp x N1Note 3 x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(5 x Kp x N1 Note 3 x Klayer1\_measurement) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: void.NOTE 3: For ATG UE with the antenna array, N1 = 3 when network assistance information on ATG cells reference locations is provided, otherwise N1 = 4.Otherwise, N1 = 1. |

Table 9.2D.5.1-2: void

Table 9.2D.5.1-3: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, ceil(3 x Kp x N1 Note 3 x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x 3 x Kp x N1 Note 3 x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil(3 x Kp x N1 Note 3 x Klayer1\_measurement) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: voidNOTE 3: For ATG UE with the antenna array, N1 = 3 when network assistance on ATG cells reference locations is provided, otherwise N1 = 4.Otherwise, N1 = 1. |

# <End of Change #4>

# <Start of Change #5>

### 9.3D.9 Inter frequency measurements without measurement gaps

#### 9.3D.9.1 Inter frequency Cell identification

UE satisfying the applicability conditions specified in 9.3D.1 on the requirement in this clause shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured) or *deriveSSB-IndexFromCellInter-r17* is configured for the FR1. Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index.

 Tidentify\_inter\_without\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter) ms

 Tidentify\_inter\_with\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter + TSSB\_time\_index\_inter) ms

Where:

- TPSS/SSS\_sync\_inter: it is the time period used in PSS/SSS detection given in table 9.3D.9.1-1.

- TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3D.9.1-3.

- TSSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3D.9.2-1.

- CSSFinter: it is a carrier specific scaling factor and is determined according to CSSFoutside\_gap,i in clause 9.1D.5.1 for measurement conducted outside measurement gaps, i.e. when interfrequency SMTC is fully non overlapping or partially overlapping with measurement gaps or according to CSSFwithin\_gap,i in clause 9.1D.5.2 for measurement conducted within measurement gaps, i.e. when interfrequency SMTC is fully overlapping with measurement gaps.

For inter-frequency SSB based measurements without measurement gaps in active BWP.

 Mpss/sss\_sync\_inter: For FR1, Mpss/sss\_sync\_inter = 5.

 MSSB\_index\_inter: For FR1, MSSB\_index\_inter = 3.

 Mmeas\_period\_inter: For FR1, Mmeas\_period\_inter = 5.

Kp is a scaling factor for an SSB frequency layer to be measured without measurement gaps. Kp = Ntotal / Navailable, where Navailable and Ntotal are calculated as follows:

 For a window W of duration max(SMTC period, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG, and starting at the beginning of any SMTC occasion:

 Ntotal is the total number of SMTC occasions within the window, including those overlapped with MG occasions within the window, and

 Navailable is the number of SMTC occasions that are not overlapped with any non-dropped MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule provided that concurrent measurement gaps are configured.

 Kp = 1 when Navailable = 0.

Otherwise, when UE is not configured with or UE does not support concurrent measurement gaps:

 When inter-frequency SMTC is fully non overlapping with measurement gaps, or inter frequency SMTC is fully overlapping with MGs, Kp =1.

 When inter frequency SMTC is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP. When inter-frequency SMTC is partially overlapping with NCSG, Kp = 1/(1- (SMTC period /VIRP)), where SMTC period < VIRP.

For UE with the antenna array,

Klayer1\_measurement=1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting outside measurement gap are not fully overlapped by intra-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting outside measurement gap and fully-overlapped by intra-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, where SSB symbols are indicated by the union set of *SSB-ToMeasure* from all the configured measurement objects on the same serving carrier which can be merged.and RSSI symbols are indicated by *SS-RSSI-Measurement*;

Klayer1\_measurement=1.5, otherwise.

Otherwise, Klayer1\_measurement=1.

If the above-mentioned reference signal configured for L1-RSRP measurement is aperiodic CSI-RS resource, longer cell identification delay would be expected.

For calculation of Kp, if the high layer signalling (TS 38.331 [2]) of *smtc2* is configured, for cells indicated in the *pci-List* parameter in *smtc2*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc1.*

Table 9.3D.9.1-1: Time period for PSS/SSS detection, (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter |
| No DRX | max( 600ms, ceil(Mpss/sss\_sync\_inter x Kp x N1 Note 4 x Klayer1\_measurement) x SMTC period )Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x Mpss/sss\_sync\_inter x Kp x N1 Note 4 x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_inter x Kp x N1 Note 4 x Klayer1\_measurement) x DRX cycle x CSSFinter |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: VoidNOTE 3: VoidNOTE 4: For ATG UE with the antenna array, N1 = 3 when network assistance on ATG cells reference locations is provided, otherwise N1 = 4.Otherwise, N1 = 1. |

Table 9.3D.9.1-2: void

Table 9.3D.9.1-3: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_inter |
| No DRX | max(120ms, ceil(MSSB\_index\_inter x Kp x N1 Note 4 x Klayer1\_measurement )x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x MSSB\_index\_inter x Kp x N1 Note 4 x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | Ceil(MSSB\_index\_inter x Kp x N1 Note 4 x Klayer1\_measurement) x DRX cycle x CSSFinter |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: VoidNOTE 3: VoidNOTE 4: For ATG UE with the antenna array, N1 = 3 when network assistance on ATG cells reference locations is provided, otherwise N1 = 4.Otherwise, N1 = 1. |

# <End of Change #5>