**3GPP TSG-RAN WG2 Meeting #123 *R2-23xxxxx***

**Toulouse, France, 21th - 25th August 2023**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.304** | **CR** | **Draft** | **rev** | **-** | **Current version:** | **17.5.0** |  |
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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 | **x** | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Running 38.304 CR for NTN | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | ZTE Corporation, Sanechips | | | | | | | | | |
| ***Source to TSG:*** | RAN2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_NTN\_enh-Core | | | | |  | ***Date:*** | | | 2023-08-31 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***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 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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
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| ***Reason for change:*** | | This CR introduces the enhancements for idle and inactive mode procedures (e.g., cell reselection enhancements) specified as part of the Work Item on Non-Terrestrial network in NR. | | | | | | | | |
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| ***Summary of change:*** | | 1. Add Abbreviation for TN. 2. Add description of location-based measurement initiation for earth-moving cell and the related parameters. 3. Add description of measurement relaxation when there is no TN coverage. | | | | | | | | |
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| ***Consequences if not approved:*** | | Enhancements or idle and inactive mode procedures agreed as part of WI on Non-Terrestrial network in NR are not specified in TS38.304. | | | | | | | | |
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| ***Clauses affected:*** | | 3.2, 5.2.4.2, 5.2.4.7.0 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS/TR 38.300 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*

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

AS Access Stratum

CAG Closed Access Group

CAG-ID Closed Access Group Identifier

CMAS Commercial Mobile Alert System

CN Core Network

DCI Downlink Control Information

DRX Discontinuous Reception

eDRX Extended DRX

ETWS Earthquake and Tsunami Warning System

E-UTRA Evolved UMTS Terrestrial Radio Access

E-UTRAN Evolved UMTS Terrestrial Radio Access Network

GIN Group ID for Network selection

H-SFN Hyper System Frame Number

HRNN Human-Readable Network Name

HSDN High Speed Dedicated Network

IAB Integrated Access and Backhaul

IMSI International Mobile Subscriber Identity

L2 Layer-2

MBS Multicast/Broadcast Services

MBS FSAI MBS Frequency Selection Area Identity

MCC Mobile Country Code

MCCH MBS Control Channel

MICO Mobile Initiated Connection Only

MRB MBS Radio Bearer

MTCH MBS Traffic Channel

NAS Non-Access Stratum

NID Network Identifier

NPN Non-Public Network

NR NR Radio Access

NSAG Network Slice AS Group

NTN Non-Terrestrial Network

PEI Paging Early Indication

PEI-O Paging Early Indication-Occasion

PH Paging Hyperframe

PLMN Public Land Mobile Network

PTW Paging Time Window

RAT Radio Access Technology

RNA RAN-based Notification Area

RNAU RAN-based Notification Area Update

RRC Radio Resource Control

SDT Small Data Transmission

SL Sidelink

SNPN Stand-alone Non-Public Network

TN Terrestrial Network

TRS Tracking Reference Signal

U2N UE-to-Network

UAC Unified Access Control

UE User Equipment

UMTS Universal Mobile Telecommunications System

V2X Vehicle to Everything

*NEXT CHANGE*

#### 5.2.4.2 Measurement rules for cell re-selection

Following rules are used by the UE to limit needed measurements:

- If the serving cell fulfils Srxlev> SIntraSearchP and Squal > SIntraSearchQ:

- If *distanceThresh* and *referenceLocation* are broadcasted in SIB19, and if UE supports location-based measurement initiation for NTN quasi-Earth-fixed system and has obtained its location information:

- If the distance between UE and the serving cell reference location *referenceLocation* is shorter than *distanceThresh*, the UE may not perform intra-frequency measurements;

- Else, the UE shall perform intra-frequency measurements;

- else if *distanceThresh* and [*movingReferenceLocation]* are broadcasted in SIB19, and if UE supports location-based measurement initiation for NTN Earth-moving system and has obtained its location information:

- If the distance between UE and the serving cell reference location determined based on [*movingReferenceLocation]* is shorter than *distanceThresh*, the UE may not perform intra-frequency measurements;

- Else, the UE shall perform intra-frequency measurements;

- Else, the UE may not perform intra-frequency measurements;

- Else, the UE shall perform intra-frequency measurements.

- The UE shall apply the following rules for NR inter-frequencies and inter-RAT frequencies which are indicated in system information and for which the UE has priority provided as defined in 5.2.4.1:

- For a NR inter-frequency or inter-RAT frequency with a reselection priority higher than the reselection priority of the current NR frequency, the UE shall perform measurements of higher priority NR inter-frequency or inter-RAT frequencies according to TS 38.133 [8].

- For a NR inter-frequency with an equal or lower reselection priority than the reselection priority of the current NR frequency and for inter-RAT frequency with lower reselection priority than the reselection priority of the current NR frequency:

- If the serving cell fulfils Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ:

- If *distanceThresh* and *referenceLocation* are broadcasted in SIB19, and if UE supports location-based measurement initiation for NTN quasi-Earth-fixed system and has obtained its UE location information:

- If the distance between UE and the serving cell reference location *referenceLocation* is shorter than *distanceThresh*, the UE may choose not to perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority;

- Else, the UE shall perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority according to TS 38.133 [8];

- else if *distanceThresh* and [*movingReferenceLocation]* are broadcasted in SIB19, and if UE supports location-based measurement initiation for NTN Earth-moving system and has obtained its location information:

- If the distance between UE and the serving cell reference location determined based on [*movingReferenceLocation]* is shorter than *distanceThresh*, the UE may choose not to perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority;

- Else, the UE shall perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority according to TS 38.133 [8];

- Else, the UE may choose not to perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority;

- Else,the UE shall perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority according to TS 38.133 [8].

- If the UE supports relaxed measurement and *relaxedMeasurement* is present in *SIB2*, the UE may further relax the needed measurements, as specified in clause 5.2.4.9.

- If the UE supports relaxed measurements on TN cells and the TN coverage associated with TN frequencies is broadcast in system information, the UE is not required to perform measurements of a TN frequency in an area, where there is no coverage of that frequency, regardless of the frequency priority.

Editor’s note: FFS whether this will be an optional UE feature.

If the *t-Service* of the serving cell is present in SIB19, and if UE supports time-based measurement initiation, the UE shall perform intra-frequency, inter-frequency or inter-RAT measurements before the *t-Service*, regardless of the distance between UE and the serving cell reference location or whether the serving cell fulfils Srxlev > SIntraSearchP and Squal > SIntraSearchQ, or Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, The exact time to start measurement before *t-Service* is up to UE implementation. UE shall perform measurements of higher priority NR inter-frequency or inter-RAT frequencies according to TS 38.133 [8] regardless of the remaining service time of the serving cell (i.e. time remaining until *t-Service*).

NOTE: When evaluating the distance between UE and the serving cell reference location, it's up to UE implementation to obtain UE location information. In the Earth-moving system, it‘s up to UE implementation to maintain a valid serving cell reference location.

*NEXT CHANGE*

#### 5.2.4.7 Cell reselection parameters in system information broadcasts

##### 5.2.4.7.0 General reselection parameters

Cell reselection parameters are broadcast in system information and are read from the serving cell as follows:

**absThreshSS-BlocksConsolidation**

This specifies the minimum threshold for beams which can be used for selection of the highest ranked cells, if *rangeToBestCell* is configured, and for beams used for derivation of cell measurement quantity. The parameter in *SIB2* applies to the current serving frequency and the parameter in *SIB4* applies to the corresponding inter-frequency.

**cellReselectionPriority**

This specifies the absolute priority for NR frequency or E-UTRAN frequency.

**cellReselectionSubPriority**

This specifies the fractional priority value added to cellReselectionPriority for NR frequency or E-UTRAN frequency.

**combineRelaxedMeasCondition**

This indicates when the UE needs to fulfil both low mobility criterion and not-at-cell-edge criterion to determine whether to relax measurement requirements.

**combineRelaxedMeasCondition2**

This indicates when a RedCap UE needs to fulfil both stationary criterion and not-at-cell-edge criterion to determine whether to relax measurement requirements.

**distanceThresh**

This indicates the distance threshold from the serving cell reference location to be used in location-based measurement initiation.

**nrofSS-BlocksToAverage**

This specifies the number of beams which can be used for selection of the highest ranked cell, if *rangeToBestCell* is configured, and the number of beams used for derivation of cell measurement quantity. The parameter in *SIB2* applies to the current serving frequency and the parameter in *SIB4* applies to the corresponding inter-frequency.

**Qoffsets,n**

This specifies the offsetbetween the two cells.

**Qoffsetfrequency**

Frequency specific offset for equal priority NR frequencies.

**Qhyst**

This specifies the hysteresis value for ranking criteria.

**Qoffsettemp**

This specifies the additional offset to be used for cell selection and re-selection. It is temporarily used in case the RRC Connection Establishment fails on the cell as specified in TS 38.331 [3].

**Qqualmin**

This specifies the minimum required quality level in the cell in dB.

**Qrxlevmin**

This specifies the minimum required Rx level in the cell in dBm.

**Qrxlevminoffsetcell**

This specifies the cell specific Rx level offset in dB to Qrxlevmin.

**Qqualminoffsetcell**

This specifies the cell specific quality level offset in dB to Qqualmin.

**rangeToBestCell**

This specifies the R value range which the cells whose R value is within the range can be a candidate for the highest ranked cell. It is configured in SIB2 and used for intra-frequency and equal priority inter-frequency cell reselection and among the cells on the highest priority frequency(ies) for inter-frequency cell reselection within NR.

**referenceLocation**

This indicates the reference location of the serving cell to be used in location-based measurement initiation for NTN quasi-Earth-fixed system.

**[movingReferenceLocation]**

This indicates the reference location of the serving cell to be used in location-based measurement initiation for NTN Earth-moving system.

**SIntraSearchP**

This specifies the Srxlev threshold (in dB) for intra-frequency measurements.

**SIntraSearchQ**

This specifies the Squal threshold (in dB) for intra-frequency measurements.

**SnonIntraSearchP**

This specifies the Srxlev threshold (in dB) for NR inter-frequency and inter-RAT measurements.

**SnonIntraSearchQ**

This specifies the Squal threshold (in dB) for NR inter-frequency and inter-RAT measurements.

**SSearchDeltaP**

This specifies the threshold (in dB) on Srxlev variation for relaxed measurement.

**SSearchDeltaP-Stationary**

This specifies the threshold (in dB) on Srxlev variation to evaluate stationary criterion for relaxed measurement.

**SSearchThresholdP**

This specifies the Srxlev threshold (in dB) for relaxed measurement.

**SSearchThresholdP2**

This specifies the Srxlev threshold (in dB) to evaluate not-at-cell-edge-criterion for relaxed measurement.

**SSearchThresholdQ**

This specifies the Squal threshold (in dB) for relaxed measurement.

**SSearchThresholdQ2**

This specifies the Squal threshold (in dB) to evaluate not-at-cell-edge-criterion for relaxed measurement.

**TreselectionRAT**

This specifies the cell reselection timer value. For each target NR frequency and for each RAT other than NR, a specific value for the cell reselection timer is defined, which is applicable when evaluating reselection within NR or towards other RAT (i.e. TreselectionRAT for NR is TreselectionNR, for E-UTRAN TreselectionEUTRA).

NOTE: TreselectionRAT is not broadcast in system information but used in reselection rules by the UE for each RAT.

**TreselectionNR**

This specifies the cell reselection timer value TreselectionRAT for NR. The parameter can be set per NR frequency as specified in TS 38.331 [3].

**TreselectionEUTRA**

This specifies the cell reselection timer value TreselectionRAT for E-UTRAN.

**ThreshX, HighP**

This specifies the Srxlev threshold (in dB) used by the UE when reselecting towards a higher priority RAT/ frequency than the current serving frequency. Each frequency of NR and E-UTRAN might have a specific threshold.

**ThreshX, HighQ**

This specifies the Squal threshold (in dB) used by the UE when reselecting towards a higher priority RAT/ frequency than the current serving frequency. Each frequency of NR and E-UTRAN might have a specific threshold.

**ThreshX, LowP**

This specifies the Srxlev threshold (in dB) used by the UE when reselecting towards a lower priority RAT/ frequency than the current serving frequency. Each frequency of NR and E-UTRAN might have a specific threshold.

**ThreshX, LowQ**

This specifies the Squal threshold (in dB) used by the UE when reselecting towards a lower priority RAT/ frequency than the current serving frequency. Each frequency of NR and E-UTRAN might have a specific threshold.

**ThreshServing, LowP**

This specifies the Srxlev threshold (in dB) used by the UE on the serving cell when reselecting towards a lower priority RAT/ frequency.

**ThreshServing, LowQ**

This specifies the Squal threshold (in dB) used by the UE on the serving cell when reselecting towards a lower priority RAT/ frequency.

**TSearchDeltaP**

This specifies the time period over which the Srxlev variation is evaluated forrelaxed measurement.

**TSearchDeltaP-Stationary**

This specifies the time period over which the Srxlev variation is evaluated for stationary criterion forrelaxed measurement.

**t-Service**

This indicates the time when a quasi-earth fixed cell is going to stop serving the area where it is currently covering, to be used in time based measurement initiation.

*End OF CHANGE*

# **Annex – Agreements for cell reselection enhancements**

## **RAN2#119e**

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| Agreements:  1. RAN2 to work on a solution so that measurements for TN’s coverage are performed only when relevant (FFS what relevant means).  2. RAN2 to work on assistance information that can be provided to NTN UEs for the above.  3. Cell reselection enhancements (for both NTN-NTN and NTN-TN mobility) are considered for both Earth-moving and (quasi-)Earth-fixed scenarios, at least via the use of system information for broadcasting necessary parameters (dedicated signalling is not precluded). FFS whether the same or different solutions are used for Earth-moving and (quasi-)Earth-fixed scenarios |

## **RAN2#119bis-e**

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| Agreements:  1.For NTN-NTN cell reselection with earth moving cell, RAN2 will consider providing parameters of serving cell to UE, for UE to estimate when the serving cell stops providing coverage at the present UE location (FFS whether this will be an optional UE feature) (this does not exclude any time-based or location-based approach) (other solutions can also be considered)  2. To enhance NTN-TN cell reselection, means are defined for a UE to differentiate when camping in an area only covered by NTN network (earth-moving or earth-fixed) vs an area where TN network(s) is/are also available. |
| Agreements:  1. System information is the basic means for providing necessary parameters to assist UE to estimate when the serving cell stops providing coverage at the present UE location.  2. UE is not required to perform neighbour cell measurements for TN neighbour cells in an area where there is no TN network coverage.  3. The method of detecting the transmission energy or SIB presence to determine the NTN coverage when a UE currently camps on a TN cell is not pursued.  4. In Earth-moving cell, the reference location and distance threshold of serving cell are provided by network for UE to estimate when the serving cell stops providing coverage at the present UE location. FFS how the reference location and/or distance threshold are provided to the UE |

## **RAN2#120**

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| Agreements:  1. RAN2 will first continue the investigation on the details of the TN coverage data (e.g. accuracy requirements for describing where TN network(s) is/are available) and UE storage overhead before deciding how to send the information to the UE.  2. Continue the discussion on whether to introduce explicit indication to identify TN cells from inter-frequency list and inter-RAT frequency list (FFS on the granularity) or whether we rely on implicit information. |

## **RAN2#121**

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| Agreements:  1. TN coverage area information will be associated to the frequency information.  2.RAN2 adopts explicit description of geographical TN area, and focuses on the following options for further discussion, taking the signalling overhead into account (FFS on the accuracy of the information):   * + Option 1: The corresponding geographical area information is provided by network with location coordinates of area center and radius.   + Option 2: a boundary line is provided by network in the format of a list of location coordinates, additionally an indication can be used to indicate which side is the TN side   + Option 6: for each TN area, a list of locations is provided by network, and the corresponding close shape could be illustrated by a polygon connecting these points within the list. |
| Agreements:  1. As a baseline, broadcast signalling is used to provide the information on the TN coverage area for UEs supporting NTN.  2. Also based on the signalling overhead of the broadcast solution, RAN2 will further consider the option that UE-specific update can be optionally be provided via dedicated signalling, overriding the broadcast configuration (FFS if via RRC or higher layers. FFS on the validity time, if provided by RRC) |
| Agreements  1.We don’t introduce additional cell reselection prioritization rules for NTN vs TN in Rel-18 (e.g. per service type, per mobility state, or per UE type) on top of what specified in Rel-17 |
| Agreements  1. In R18, for earth-moving system, satellite with steerable beam is not considered as part of mobility enhancement in NTN.  2. A serving cell reference location and a distance threshold/radius will be broadcast for earth-moving cell. FFS on whether the R17 IEs are reused or not. FFS on whether additional information needs to be broadcast to inform the UE how the reference location moves over time or if this can be derived from other information (e.g. Epoch time and ephemeris).  3.For cell selection/reselection, location-based measurement initiation is supported in earth-moving cell |
| Agreements:   1. For earth-moving cell, the location-based cell measurement rules of quasi-fixed cell is reused, i.e., for cell reselection in earth-moving cell, UE initiates measurements when its location to serving cell reference location is larger than the configured distance threshold. |

## **RAN2#121bis-e**

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| Agreements:   1. For signaling the TN coverage, the corresponding geographical area information is provided by broadcast signalling by the network via a list of (possibly overlapping) areas where each area is defined using center location coordinates + radius (where the area is meant to describe a group of cells, not just a single one). FFS on the SIB. FFS on whether additional information in dedicated signalling is needed/useful |
| Agreements:  1. Area center location and its radius for TN coverage information is signalled using Ellipsoid-Point and radius separately. FFS if Rel-17 referenceLocation and distanceThresh are directly reused  2. Decision on the size of TN coverage area list is postponed until more is known on the format of this information and how is it sent. |
| Agreements:  1. The discussion on how to indicate the frequency information for each TN coverage area should be combined with the discussion on which SIB will be used to indicate the TN coverage area, possibly based on evaluation of the signalling overhead  2. The acquired TN area coverage information remains valid until the next system information update of the SIB including TN coverage info  Working assumption:  1. We do not introduce new triggers making the UE reacquire the TN coverage information from SI |
|  |
| Agreements:  On a frequency band number shared by TN and NTN (e.g., n1), if NTN-specific assistance information is NOT provided for a neighbour cell configured in SIB3/SIB4, UE assumes this is a TN neighbour cell. This understanding is also applicable for Rel-17 and it does not need any spec update. |
| Agreements:  1. RAN2 understands that for earth-moving cell reselection, the UE can derive the trajectory of serving cell with rough accuracy based on serving satellite ephemeris and epochTime, with the assumption that the serving cell reference location broadcast by the network is the one at Epoch time (FFS whether a new epochTime IE is needed). RAN2 understanding is that both PVT and orbital parameters can be used for this. FFS if additional information is needed to allow more accurate measurements.  2. For earth-moving cell, new IE is introduced to indicate the reference location of serving cell.  3. For cell (re)selection in earth-moving system, a distance threshold is introduced for location-based measurement initiation, which reuses distanceThresh in SIB19.  4. For cell (re)selection in earth-moving system, time-based measurement initiation is used to address feeder-link switch case.  5. Time-based cell reselection criteria is not pursued in R18. |

## **RAN2#122**

Agreements:

1. An RRC\_IDLE/RRC\_INACTIVE UE is not required to perform neighbour cell measurements for cell reselection for a TN frequency in the area, if configured, where there is no coverage of that frequency, regardless of the frequency priority
2. Reuse the same format of Rel-17 referenceLocation and distanceThresh for signaling the TN coverage area centre and radius
3. TN coverage info is NOT included in SIB19. FFS if we use an existing SIB or a new one
4. We don’t introduce RRC dedicated signalling to provide more accurate TN coverage information
5. We no longer consider option 3 alone for signaling the frequency information for TN coverage area (in case option 3 should be combined with option 1). Come back in the next meeting to decide between option 2 (plus possible fixes if needed) and option 1+3.
6. Re-use epochTime-r17 in ntn-Config IE to provide the time reference for an Earth moving cell reference location.
7. Re-use t-Service-r17 format for the IE used to trigger UE neighbour cell measurements prior to cell replacement due to feeder link switch. FFS whether we reuse exactly the same IE name as in R17 (updating the field description) or a new one
8. Location-based cell reselection criteria are not pursued in R18.

## **RAN2#123**

Agreements:

1. Both of the NR TN coverage and EUTRA TN coverage can be provided.
2. We introduce a new SIB to provide the TN coverage information.
3. A TN coverage area configuration is associated with a TN coverage Area ID. The frequency information for TN coverage area is indicated by adding TN coverage area IDs in SIB4 and SIB5.
4. The change of serving cell reference location for earth moving cell should neither result in system information change notifications nor in a modification of valueTag in SIB1.
5. In the Earth-moving case, it is up to UE implementation to maintain a valid serving cell reference location in RRC\_IDLE and RRC\_Inactive mode. This will be stated in the specification as a Note (or update of an existing Note).
6. For the IE used to trigger UE neighbor cell measurements prior to feeder link switch, re-use the same field of t-Service-17 as in Rel-17 and update the field description accordingly.