3GPP RAN WG2 Meeting #124 R2-231xxxx

Chicago, United States, November 13th – 17th, 2023

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **38.321** | **CR** | **xxxx** | **rev** | **-** | **Current version:** | **17.6.0** |  |
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| *For* [*HELP*](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:***  | Introduction of Rel-18 NTN enhancements to TS 38.321 |
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| ***Source to WG:*** | InterDigital  |
| ***Source to TSG:*** | RAN2 |
|  |  |
| ***Work item code:*** | NR\_NTN\_enh-Core |  | ***Date:*** | 2023-12-01 |
|  |  |  |  |  |
| ***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 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:*** | Introduction of Release-18 support for non-terrestrial network enhancements |
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| ***Summary of change:*** | The changes within introduce support for hard and soft satellite switch with resynchronization to TS 38.321 |
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| ***Consequences if not approved:*** | No support for Release-18 non-terrestrial networks enhancements |
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| ***Clauses affected:*** | 5.2a |
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|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.300 CR 0734  |
| ***affected:*** |  | **X** |  Test specifications | TS 38.306 CR 0357  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS 38.331 CR 4501 |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | - |

<<<<<<<<<<<<<<<<<<<< First change begins >>>>>>>>>>>>>>>>>>>>

## 5.2a Maintenance of UL Synchronization

The MAC entity shall for each Serving Cell:

1> if an indication of uplink synchronization has been received from upper layers (see clause 5.2.2.6 and 5.2.2.X of TS 38.331 [5]):

2> if indication of uplink synchronization is received after indication of uplink synchronization loss due to satellite switch with re-synchronization:

3> set NTA value (as defined in TS 38.211 [8]) to zero for PTAG;

3> indicate to lower layers a Differential Koffset with value zero.

2> allow uplink transmission on the Serving Cell.

1> if an indication of uplink synchronization loss or uplink synchronization loss due to satellite switch with re-synchronization is received from upper layers (see clause 5.2.2.6 and 5.2.2.X of TS 38.331 [5]):

2> flush all HARQ buffers;

2> not perform any uplink transmission on the Serving Cell.

NOTE: The MAC entity suspends all UL operations (e.g. stop RACH, SR, and UL HARQ operation) after receiving the indication of an uplink synchronization loss and resumes the operation when receiving an indication of uplink synchronization.

<<<<<<<<<<<<<<<<<<<< End of changes >>>>>>>>>>>>>>>>>>>>

# Annex – Agreements

### RAN2#124 Agreements: NR-NTN

introduce one new target satellite configuration, e.g. ntn-TargetSatConfig, (but we can keep the current terminology in the running CR) and provide the NTN-config of the target satellite in it for the specific signaling format about the target satellite information in SIB19. The presence of this information indicates that satellite switch without PCI change is supported

At least for soft switch, there needs to be an “SSB time offset” between the source and the target satellite. “SSB time offset” is specified as a new IE, with the same format as “offset” in SSB-MTC4

Target satellite SSB tracking is handled autonomously by the UE based on the provided SSB time offset

The “SSB time offset” between the source and the target satellite should be provided in SIB19

Support implicit indication to inform UE it is hard switch or soft switch case

For soft satellite switch, as a baseline, it is sufficient to provide the “SSB time offset” of the target satellite in SIB19. (Can come back in the next meeting to check whether a different SSB index for the target satellite can optionally be provided)

T-start is explicitly signalled (same format as T-service). If T-start is not signalled, T-start is assumed to be equal to T-service, i.e. hard switch.

For R18 we clarify that signalling a T-start higher than T-service is an unforeseen case and the UE will assume T-start = T-service

During satellite switching procedure, UE should reset the L3 filter for serving cell RRM measurement and RLM, and it’s up to UE implementation (i.e. no RAN2 spec impact).

If UE receive the HO command before UE initiates the satellite switching procedure (i.e. before the time point of satellite switching), UE will initiate the HO procedure immediately.

Both CHO and satellite switching procedure can be configured simultaneously.

When both CHO (for a different cell) and satellite switching procedure are configured, the UE initiates the procedure that triggers earlier; it's up to UE implementation if both procedures are triggered at the same time.

This feature will be called “satellite switch with re-sync”

RACH-less satellite switch procedure as shown in Figure-1 in R2-2313877 is endorsed as the baseline to be further checked in the CR review

Check in the RRC CR review whether the UE may need to acquire SIB19 immediately when UE acquires DL sync of target satellite

A UE supporting TA reporting may trigger TAR and TAR-SR based on network configuration (as in legacy)

It is up to NW implementation to signal T-start, e.g. if it does not want to receive UL TX before T-service (if there is no T-start, UL TX cannot happen before T-service)

We don’t introduce specific changes (e.g. no new indication in SIB19) to a support RACH-based procedure but this does not exclude the possibility for the NW to trigger PDCCH order

### RAN2#123bis Agreements

We don’t consider the impact on Rel-17 UEs behavior (or Rel-18 UEs not supporting unchanged PCI) when defining the Rel-18 unchanged PCI solution

Network provides the sync information of target satellite in advance to UE before satellite switching, via broadcast signalling

RAN2 confirms satellite switching with unchanged PCI is only applicable on quasi-earth fixed system

Only 1 target satellite information (i.e. NTN-config) of serving cell is provided in SIB19. FFS on exact signalling

SMTC configuration of target satellite needs further discussion:

 FFS on whether and how to provide the SMTC configuration of target satellite.

 FFS on how to handle the SMTC adjustment.

We support soft satellite switching in Rel-18

There will be an indication (FFS if explicit or implicit) whether hard switch or soft switch is used.

At least soft satellite switching, network provides SSB information of target satellite to UE. FFS on the details: options include e.g. indicating a time offset/information or indicating a different SSB index for the target satellite (FFS for Hard satellite switch)

In soft satellite switching, UE can start synchronizing with target satellite before T-service of source satellite.

We introduce a T-start which indicates the earliest occasion when the UE can start synchronizing with target satellite (actual signalling is FFS). In soft switch scenario, T-start of target satellite is earlier than T-service of source satellite (FFS if T-start is also used for hard satellite switch)

For soft satellite switching, the exact time when the UE starts synchronizing with target satellite (between T-start and T-service) is up to UE implementation

UE is not required to connect to source satellite when the UE switches to target satellite.

### RAN2#123 Agreements

An explicit indication will be introduced to enable the unchanged PCI switch

The unchanged PCI mechanism can be applied to the case where the coverage gap is zero or negligible (where there is no need to introduce t-gap or t-start). FFS whether we need to support scenarios that require the introduction of t-gap or t-start

PCI unchanged procedure can be performed without performing RACH

In the unchanged PCI case, the UE considers UL synchronization timer expired at t-Service (current cell stop time) to stop any UL operation. FFS on timeAlignmentTimer handling.

In the unchanged PCI case, for RACH-based solution, the UE may trigger RACH immediately after DL synchronizing with the new satellite

The UE specific Koffset, if configured, is not used after t-Service and the UE uses the cell specifc Koffset until the UE receives new differential Koffset MAC CE.

### RAN2#121bis-e Agreements

t-Service in SIB19 can also be interpreted by Rel-18 UE in Connected mode to know that a satellite change or feeder link change happens

In hard switch unchanged PCI scenario (i.e. no handover), the UE needs to know the time the UE attempts to re-synchronize. (FFS whether a new “t-Start” / a t-gap is needed or whether t-Service can be reused (i.e. no other IE) if the gap is very short/zero).

### RAN2#121bis-e Agreements

### RAN2#121e Agreements

Working Assumption: In quasi-earth fixed cell case, for hard satellite switch in the same SSB frequency and same gNB (no key change), satellite switching without PCI changing (not requiring L3 mobility) is supported

### RAN2#120 Agreements

### RAN2#119bis-e Agreements

RAN2 continues the discussion (e.g. at RAN2#120) on the solution with keeping the same PCI after switching of the satellites. Clarify at least the following:

* RAN1 impact
* The need to perform UL beam switching and/or RA
* Applicability to hard or soft satellite switching