**3GPP RAN WG2 Meeting #125bis R2-240xxxx**

**Changsha, China, April 15th – 19th, 2024**

**Agenda Item: 7.0.4**

**Source: Samsung, InterDigital**

**Title: [DRAFT] Report of [POST125][024][RACH-less] Remaining issues**

**Document for: Discussion, Decision**

1. Introduction

This document is a report of the following email discussion:

* [POST125][024][RACH-less] Remaining issues (Samsung, InterDigital)

 Intended outcome: UE capability discussion and other RACH-less issues/corrections taking into account the latest merged CR

 Deadline: Mar 29, 1000 UTC

Section 2 includes the UE capability discussion for RACH-less HO

Section 3 discusses contributions submitted to AIs 7.7.3 and 7.7.4, which propose other corrections/issues to the RACH-less HO procedure including:

* [R2-2400249](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400249.zip): [C604] [C622] On parameter applicability to CG RACH-less HO in NR NTN - CATT
* [R2-2400803](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400803.zip): MAC corrections for NTN – InterDigital
* [R2-2400810](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400810.zip): Corrections on NTN MAC issues - Samsung
* [R2-2400869](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400869.zip): Discussion on configuration of ntn-cg-RACH-less-RetransmissionTimer - LG
* [R2-2400871](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400871.zip): Indication for HARQ feedback for RACH-less handover - LG
* [R2-2400882](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400882.zip): Discussion on remaining issues of RACH-less handover for NTN – NEC
* [R2-2400939](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400939.zip): Clarification on UE operation upon TATimer expiry during RACH-less HO - Apple
* [R2-2401281](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2401281.zip): Discussion on MAC behaviours related to RACH-less HO and unchanged PCI - Huawei, HiSilicon

A brief summary of the issue(s) discussed within each document have been provided below, however companies are encouraged to refer to the original contribution for further details/motivation. Parameter names have been updated throughout the document based on the generalized RACH-less procedure according to CRs [R2-2401686](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Inbox/R2-2401686.zip) and [R2-2402030](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Inbox/R2-2402030.zip).

Furthermore, issues described within Section 3 of this document may be more relevant to a specific feature (NTN). When necessary, companies are encouraged to clarify whether a response is applicable to the general case or should be restricted to one or more feature(s).

In Section 4, companies may indicate any other identified issues with RACH-less HO not addressed within this document.

# Capabilities discussion

At RAN2#125 (Athens, February/March 2024), the following was agreed on the topic of RACH-less HO (originally introduced for NTN and then extended to mIAB, and then in Athens extended to all R18 UEs as per below):

**Agreements on RACH-less HO**

1. We will generalize RACH-less HO without impact to RAN3 in Rel-18

2. Two UE capabilities will be introduced: DG RACH-less HO and CG RACH-less HO. FFS if it is per band. FFS how we handle NTN capability if different from mIAB and generalized case

The following is an exhaustive list of remaining options on handling RACH-less HO capabilities (CHO for NTN case is handled in a separate question):

**Option 1 (no separate handling of NTN case)**. A total of two RACH-less HO capabilities are introduced in R18 (and previously agreed NTN RACH-less HO capability is removed):

* per-UE DG RACH-less HO,
* per-UE CG RACH-less HO

**Option 2 (no separate handling of NTN case).** A total of two RACH-less HO capabilities are introduced in R18 (and previously agreed NTN RACH-less HO capability is removed):

* per-band DG RACH-less HO,
* per-band CG RACH-less HO

**Option 3 (separate handling of NTN case).** A total of three RACH-less HO capabilities are introduced in R18:

* per-UE DG RACH-less HO (mIAB and all other non-NTN R18 UEs),
* per-UE CG RACH-less HO (mIAB and all other non-NTN R18 UEs),
* per-band NTN RACH-less HO capability.

**Option 4 (separate handling of NTN case).** A total of three RACH-less HO capabilities are introduced in R18:

* per-band DG RACH-less HO (mIAB and all other non-NTN R18 UEs),
* per-band CG RACH-less HO (mIAB and all other non-NTN R18 UEs),
* per-band NTN RACH-less HO capability.

**Question 1) Which of the above options is your preferred option?**

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| **Company** | **Option 1/2/3/4** | **Comment** |
| Ericsson | Option 2 | Given that in 38.306 all the capabilities related to handover are per-Band, we can align also here. We don’t see the need to have a separate capability for NTN has the per-band already allows a UE which support NTN to signal the support of RACH-less handover for the different NTN bands. |
| Nokia | Option 2 | Similar view with Ericsson - Option 2 allows not to separate NTN capability, as it will be implicitly separated if RACH-less is signalled per band (NTN has separate pool of bands). |
| NEC | Option2 | Similar view with Ericsson and Nokia |
| ZTE | Option 3 | Considering UE behaviour for NTN RACH-less HO is different from other cases, separate capability for NTN can be considered. (However, we would like to point out that even if per-band is agreed for NTN RACH-less HO, the UE is required to set the capability value to the same value for all FDD-FR1 NTN bands, so, it can be considered as per-UE capability).Regarding the granularity, the RACH-less capabilities for LTM are defined as per-UE level, we think the same principle can be applied to other cases. (note that in LTE, the RACH-less HO capability is also defined as per-UE level.) |

At RAN2#125, RAN2 additionally discussed whether a separate RACH-less HO capability is needed for the special case of NTN time-based RACH-less CHO. It should be noted that the CHO referred here is a time-based CHO which is only applicable to NTN. With this in mind, the companies are invited to provide answers to the following two questions:

**Question 2) Do you agree that there is no need for a RACH-less CHO capability for non-NTN R18 UEs?**

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| **Company** | **Agree/Do not agree** | **Comment** |
| Ericsson | Yes | This is an NTN-specific feature and was never discussed in the Mobile IAB WI (for instance). At least in this release, we prefer to keep this NTN specific and not extend this feature to non-NTN UEs. |
| Nokia | Yes | Same view with Ericsson |
| NEC |  | See common to Q3 |
| ZTE | Agree | There is no conclusion to extend RACH-less CHO to other cases in Rel-18. It can be discussed in Rel-19, if needed.  |
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**Question 3) Do you support introducing a RACH-less CHO capability for NTN R18 UEs?**

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| **Company** | **Support/Do not support** | **Comment** |
| Ericsson | Support (per-Band capability) | This has to be the case. Otherwise, a UE which reports the RACH-less HO capability would need mandatorily to implement also CHO, which should not be the case.  |
| Nokia | Maybe support (see comment by using existing capabilities) | Alternatively, as RACH-less has a separate per band capability, CHO in NTN has its own capability, maybe signalling these two can also imply the support of RACH-less CHO? |
| NEC | see comment | Maybe we can gereralize this too, that, a UE who support RACH-less and also CHO for a band, will support RACH-less CHO consequently, with the understanding that RACH-less handling for CHO and HO is same. |
| ZTE | Do not support | If separate capabilities are defined for CHO and RACH-less, then there is no need to introduce separate capability for “RACH-less CHO”. If the UE indicates the support of both CHO and RACH-less, it means the UE supports RACH-less CHO. If UE does not support either CHO or RACH-less, it means RACH-less CHO cannot be supported.  |
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And finally, companies are invited to share any comments related to RACH-less HO capabilities not covered by the discussion above:

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| **Company** | **Any other issue** |
| Ericsson | Not really an issue, but maybe good to clarify that the understanding of such capabilities (for whatever option we will agree) are not expenciting to have any FDD/TDD and FR1/FR2 differentiation. |
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# Other corrections to RACH-less HO

## CG RACH-less handover

### CG-SDT parameter applicability to RACH-less HO

[R2-2400249](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400249.zip) discusses the applicability of CG-SDT parameters to RACH-less HO, noting that some L1 parameters are directly copied-pasted from CG-SDT config (agreed as baseline) to CG RACH-less HO config. [[R2-2400249](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400249.zip)] mentions RAN1 has never concluded on the necessary L1 parameters for CG RACH-less HO, so the correctness of the L1 parameters currently specified for CG RACH-less HO was never justified.

The following parameters from *CG-RRC-RACH-LessConfiguration* are mentioned:

* ***rrc-NrofDMRS-Sequences*** and ***rrc-DMRS-Port*** which were copied directly from CG-SDT without RAN1 confirmation on applicability to RACH-less HO;
* ***rrc-SSB-PerCG-PUSCH*, *rrc-SSB-Subset*** and ***cg-RRC-RSRP-ThresholdSSB***, which could need RAN1 confirmation on whether the value range from CG-SDT is suitable for CG-RACH-less HO, particularly for the NR NTN scenario.

As well as the following parameters from *rrc-ConfiguredUplinkGrant*:

* ***antennaPort, pathlossReferenceIndex, phy-PriorityIndex, srs-ResourceIndicator*** *and* ***precodingAndNumberOfLayers*:** These parameters were decided by RAN1 as not applicable for CG-SDT, and thus there are restrictions intentionally specified in the field description to indicate their inapplicability once CG-SDT is configured. [[R2-2400249](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400249.zip)] doubts whether RAN2 alone can conclude whether they are applicable to CG RACH-less HO in NTN and we should check with RAN1 on their applicability.

**Question 4a) Do you agree to send an LS to RAN1 to check whether parameters used for CG RACH-less HO (e.g., within *CG-RRC-RACH-LessConfiguration* and/or *rrc-ConfiguredUplinkGrant*) are correctly specified?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | Agree | We think an LS would be helpful, but actual content of the LS and which parameters to mention needs more discussion. |
| Nokia | Maybe | If there is something to be asked then yes but I everything is clear no need.  |
| NEC | Agree |  |
| ZTE | Agree | We are ok to send LS to RAN1, maybe it is simpler to ask RAN1 to check all the RAN1 related parameters.  |
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**Question 4b) If ‘agree’ to Question 4a), which of the following parameters should be included in the LS to RAN1?**

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| **From *CG-RRC-RACH-LessConfiguration*** | **From *rrc-ConfiguredUplinkGrant*** |
| **1. rrc-NRofDMRS-Sequences**  | **6. antennaPort** |
| **2. rrc-DMRS-Port**  | **7. pathlossReferenceIndex** |
| **3. rrc-SSB-PerCG-PUSCH,**  | **8. phy-PriorityIndex** |
| **4. cg-RRC-RSRP-ThresholdSSB**  | **9. srs-ResourceIndicator** |
| **5. rrc-SSB-Subset** | **10. precodingAndNumberOfLayers** |

**NOTE: If there are other parameters not listed above which require RAN1 confirmation, please include them in the ‘Additional Comments’ section and provide justification why this is needed.**

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| **Company** | **Which parameter(s) (e.g., 1, 3, 5-10)** | **Additional comments**  |
| Ericsson | See comment | Probably we don’t need to mention specific parameters, but we can simply refer to the parent fields in our RRC specification and ask them if they see any issues. Another approach, would be to simply describe what RAN2 is after (re-using the CG-SDT approach for RACH-less HO) and ask them to inform us about which parameters are not needed and which ones apply. |
| Nokia |  | Agree with more generic approach as Ericsson proposes |
| NEC |  | Agree with Ericsson |
| ZTE |  | Agree with Ericsson.  |
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[R2-2400249](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400249.zip) further notes ***uci-OnPUSCH*** is used for selection between configuration of dynamic and semi-static beta-offset. Since the CG in RACH-less HO is mainly used to transmit *RRCReconfigurationComplete*, the overlapping between PUCCH and PUSCH is a rare case. Therefore, [[R2-2400249](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400249.zip)] thinks the network needs to guarantee that this parameter is not configured for CG in RACH-less HO, and that similar to CG-SDT, this needs to be clarified in the specification.

**Question 4c) Do you agree that the network does not configure *uci-OnPUSCH* for CG RACH-less HO?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | See comments | In principle this should be okay, but if we send an LS to RAN1 we should wait for them before to decide. |
| ZTE | See comments | We can ask RAN1 for confirmation.  |
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Finally, [R2-2400249](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400249.zip) notes that ***cg-RetransmissionTimer*** and ***harq-ProcID-Offset*** were originally introduced in NR-U, and since NR NTN does not work on the unlicensed band they need not be included (at least in NTN). The network should thus guarantee that these two parameters are not configured for NTN RACH-less HO.

**Question 4d) Do you agree that the network does not configure *cg-RetransmissionTimer* and *harq-ProcID-Offset* for CG RACH-less HO?**

**NOTE: If ‘Agree’, please indicate whether these should not be configured in the general case, or only for a specific feature(s) (e.g., NTN)**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | Agree but | The current field descriptions of cg-RetransmissionTimer and harq-ProcID-Offset already take care of this case. Therefore, we see that no specification impact is forseen on this. |
| Nokia | Agree | But likely nothing needs to be captured as NW will simply not configure those in NTN. |
| NEC | Agree | The current field description already captured that these two fields are configurd for operation with shared spectrum channel access, not for operation in licensed spectrum. No further clarification is needed in specification for NTN. |
| ZTE | Agree | Agree with Ericsson. |
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### Configuration of *cg-RRC-RetransmissionTimer* in NTN

**Issue 1: Extension of the *cg-RRC-RetransmissionTimer* in NTN scenario:**

[[R2-2400249](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400249.zip)] explains that *cg-RRC-RetransmissionTimer* is used to indicate the initial value of the configured grant retransmission timer used for the initial uplink transmission of RACH-less HO, and like *configuredGrantTimer* (which was extended in Rel-17 NTN), the *cg-RRC-RetransmissionTimer* should also be extended considering the large RTT in NTN. To leave enough time for UE to wait for gNB's dynamic scheduling for CG retransmission, [[R2-2400249](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400249.zip)] proposes that the maximum value can be similarly set to the same maximum value of *configuredGrantTimer* in NTN.

**Question 5) Do you agree the value of *cg-RRC-RetransmissionTimer* should be (at least) extended as large as *configuredGrantTimer* in NR NTN?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | Agree but | In principle this should be fine |
| Nokia | Agree | We should extend these in NTN |
| NEC | Agree |  |
| ZTE | Agree | The same value range as configuredGrantTimer is sufficient. |
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**Issue 2: Configuration of *cg-RRC-RetransmissionTimer* relative to *HARQ-RTT-TimerUL-NTN***

[R2-2400869](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400869.zip) discusses configuration of *cg-RRC-RetransmissionTimer* relative to *HARQ-RTT-TimerUL-NTN*, noting that if the *cg-RRC-RetransmissionTimer* is larger than the *HARQ-RTT-TimerUL-NTN* it could delay RACH-less handover completion (companies are encouraged to refer to [R2-2400869](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400869.zip) for a detailed example). To avoid this, [R2-2400869](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400869.zip) suggests to always configure *cg-RRC-RetransmissionTimer* to be shorter than *HARQ-RTT-TimerUL-NTN*. Since there is no such restriction in the current specification, [R2-2400869](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400869.zip) proposes to add one in RRC.

**Question 6) Do you agree to specify a restriction in RRC that *cg-RRC-RetransmissionTimer* is always configured shorter than *HARQ-RTT-TimerUL-NTN*?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | Disagree | This is a network configuration and there is no need to have any restriction. It should be up to the network to guarantee that the RACH-less HO is not delayed. |
| Nokia | Disagree | Even though the explanation from 00869 is valid, it could be left to the NW to ensure harq RTT timer is not shorter than CG reTx timer. |
| NEC | Disagree | It can be left to the network implementation to guarantee this. No need to specify anything in specification. |
| ZTE | Disagree | Share similar views as Ericsson |
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### General corrections to CG RACH-less retransmission

The following was agreed RAN2#123 meeting, regarding the mapping between CG and SSBs for CG-RACH-less HO during initial UL transmission:

* The pre-allocated grant is provided with association to SSBs
* The mapping between type-1 CG and SSBs in CG-SDT can be the baseline of how to configure pre-allocated grant mapped to SSBs (can rediscuss in case of different input from RAN1)
* UE selects an SSB associated to the pre-allocated grant with RSRP above a configured threshold, use the selected SSB and the corresponding UL grant occasions for the initial UL transmission
* If no SSB mapping to pre-allocated grant has RSRP above the threshold, fallback to RACH HO (with new SSB selection), while T304 is running

Which was subsequently specified in TS 38.321 clause 5.8.2 as follows:

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| For an uplink grant configured for configured grant Type 1 for RACH-less handover, when RACH-less handover is triggered and not terminated, for each configured uplink grant valid according to TS 38.214 [7] for which the above formula is satisfied, the MAC entity shall:1> if, after the initial transmission of RACH-less handover has been performed according to clause 5.4.1 and 5.33, PDCCH addressed to the MAC entity's C-RNTI has not been received:2> if the SSB corresponding to the configured UL grant has the same SSB index as the SSB selected for the initial transmission of RACH-less handover (i.e., retransmission of initial transmission of RACH-less handover):3> select this SSB;3> indicate the SSB index corresponding to the configured uplink grant to the lower layer;3> consider this configured uplink grant as valid.1> else if at least one SSB corresponding to the configured uplink grant with SS-RSRP above *rach-less-RSRP-ThresholdSSB* is available:2> select an SSB with SS-RSRP above *rach-less-RSRP-ThresholdSSB* amongst the SSB(s) associated with the configured uplink grant;2> indicate the selected SSB index to the lower layer;2> consider this configured uplink grant as valid.1> else:2> consider this configured uplink grant as not valid;2> initiate Random Access procedure in clause 5.1. |

[R2-2400810](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400810.zip) interprets the above agreements from RAN2#123 to mean “when no SSB for CG (i.e., all CG occasions) has RSRP above the threshold, i.e., when none of the CG occasions is valid, RACH is initiated”. However, [[R2-2400810](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400810.zip)] notes the current procedure of the blue highlighted part is that for each configured uplink grant, if no SSB corresponding to the configured uplink grant has RSRP above the threshold, consider this configured uplink grant as not valid and initiate RACH.

[[R2-2400810](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400810.zip)] therefore states the current implementation is not correct, and instead proposes a different condition for initiating RACH similar to CD-SDT case, i.e., “if no SSB configured for *cg-RRC-RACH-Less-Configuration* with SS-RSRP above *cg-RRC-RSRP-ThresholdSSB* is available, initiate RACH”.

**Question 7) Do you agree to change the condition for RACH initiation when no CG is valid for RACH-less HO as: “if no SSB configured for *cg-RRC-RACH-Less-Configuration* with SS-RSRP above cg-*RRC-RSRP-ThresholdSSB* is available, initiate RACH”?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | Disagree | We don’t really see the point of having such change. What is propose achieve exactly the same that is in present spec. |
| Nokia | Disagree | The current text says “if at least one SSB corresponding to the configured uplink grant” we believe the term corresponding to the configured uplink grant covers the concern raised. So no change is needed. |
| NEC | Disagree | We think the blue highligheted “1>else” already means that there is no SSB with ss-RSRP above cg-RRC-RSRP-ThresholdSSB is available, the current description is clear. |
| ZTE | Disagree | Same view as above companies.  |
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## Definition of when RACH-less HO is “ongoing”

The terminology “ongoing RACH-less HO procedure” is used throughout TS 38.321 (e.g., in Sections 5.3.1, 5.4.1, 5.7, and 5.14), however both [R2-2400803](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400803.zip) and [R2-2400810](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400810.zip) note that unlike LTM, there is no explicit definition of when a RACH-less HO procedure is considered “ongoing”. [[R2-2400803](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400803.zip)] proposes the following may be considered for how a MAC entity interprets a RACH-less handover procedure is ongoing:

* **No further clarification is needed:** the current text in Section 5.33 is considered sufficient to indicate the initiation of the RACH-less HO procedure in MAC, and the procedure is assumed ongoing until terminated via other sections of the specification (e.g., 5.3.1 or 5.4.1).
* **Explicitly define in MAC when the UE considers RACH-less HO procedure ongoing (like LTM)** Initiation of an LTM cell switch is defined in Section 5.18.35 via reception of an LTM Cell Switch Command MAC CE, and when the MAC entity considers RACH-less LTM cell switch as “ongoing” is explicitly specified. Similar text may be included for RACH-less HO.
* **Add a clarifying note** An alternative to explicit procedural text would be to add a clarifying note (e.g., to the end of Section 5.33).

**Question 8a) Which of the following options do you prefer regarding clarification of when MAC considers the RACH-less handover procedure to be “ongoing”:**

**Option 1: No change is needed, current specification is clear.**

**Option 2: Introduce explicit procedural text like the RACH-less LTM Cell Switch procedure.**

**Option 3: Add a clarifying note.**

**Option 4: Other, please describe**

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| **Company** | **Preferred Option?** | **Additional comments**  |
| Ericsson | Option 1 | We think there is no need to overclarify this as the RACH-less HO will be anyway terminated in other sections. Also, RACH-less HO is still an “handover” and thus there is no room for any misunderstanding. For LTM this was needed as there we don’t use the normal handover command but instead a MAC CE. |
| Nokia | Option 1 | TS 38.331 – section 5.3.5.5.2 has the following text“3> if *rach-LessHO* is included:4> configure lower layers in accordance with *rach-LessHO* for the target SpCell;”We believe this text is clear to indicate to MAC layer that the RACH-less HO is on-going. |
| NEC | Option 1 |  |
| ZTE | Option 1 |  |
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Regarding how this may be clarified, [R2-2400803](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400803.zip) explains that upon execution of a reconfiguration with sync including *rach-LessHO*, RRC configures lower layers in accordance with *rach-lessHO* for the target SpCell. TS 38.321 Section 5.33 specifies that when *rach-lessHO* is configured, the MAC entity either selects a CG occasion for initial UL transmission (in CG case) or monitors for dynamic grant for initial UL transmission (in DG case). [[R2-2400803](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400803.zip)] states this may be considered as the “start” of the RACH-less HO procedure, and defining text added to Section 5.33 as follows:

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| When *rach-LessHO* is configured, the MAC entity shall:1> consider the RACH-less handover procedure to be ongoing;1> if *cg-RACH-less-Configuration* is configured:2> select a configured uplink grant for initial uplink transmission according to clause 5.8.2;2> perform initial uplink transmission in the first available CG occasion for RACH-less handover according to clause 5.8.2. |

Alternatively, [R2-2400810](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400810.zip) proposes that it can be added in clause 5.2 as follows:

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| 1> when the MAC entity is configured with *rach-LessHO*:2> set the NTA value (as defined in TS 38.211 [8]) to the value indicated by *targetNTA* in *rach-LessHO* for PTAG;2> start the *timeAlignmentTimer* associated with PTAG;2> consider the RACH-less HO procedure to be ongoing. |

**Question 8b) If ‘Option 2’ from Question 5a, where should the clarification of “ongoing RACH-less HO procedure” be specified?**

**Option 1: In Section 5.33 (like [**[R2-2400803](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400803.zip)**])**

**Option 2: In Section 5.2 (like [**[R2-2400810](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400810.zip)**])**

**Option 3: Other, please describe**

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| **Company** | **Preferred Option?** | **Additional comments**  |
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For CG-based RACH-less HO, the procedure for initial UL transmission is specified as follows currently in TS 38.321 clause 5.8.2.

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| For an uplink grant configured for configured grant Type 1 for RACH-less handover, when RACH-less handover is triggered and not terminated, for each configured uplink grant valid according to TS 38.214 [7] for which the above formula is satisfied, the MAC entity shall: |

[R2-2400810](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400810.zip) notes that the highlighted phrase is slightly misleading that it can mean RACH-less is not failed/terminated due to T304 expiry, yet the intention is that the procedure is applied when there is an on-going RACH-less HO. [[R2-2400810](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400810.zip)] proposed to replace " when RACH-less handover is triggered and not terminated " by “when there is an on-going RACH-less HO procedure”, which is better aligned with the phasing used elsewhere.

**Question 9) For CG-based RACH-less HO procedure in clause 5.8.2, do you agree to replace " when RACH-less handover is triggered and not terminated " with “when there is an on-going RACH-less HO procedure”?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | Agree | This should be okay. |
| Nokia  | Disagree | The proponent aims to align the CG text used for LTM. In LTM case – there is no consideration of SSB threshold for the validity of the CG.The aim of the text of considering RACH-less HO terminated is that there maybe no valid CG with the corresponding SSBs. If that is the case – UE should initiate random access and not come back to this clause to evaluate SSBs again. |
| NEC | Agree  | In our understanding the descriptions “RACH-less HO is not terminated” and “RACH-less HO is on-going” have the same meaning. And it is better to align the text for LTM. |
| ZTE | Disagree | The outcome of 5.8.2 can be triggering RACH procedure (e.g. when no CG is considered as valid). So, it is misleading to say “when there is on-going RACH-less HO procedure”. Because it is unclear whether “there is on-going RACH-less HO procedure” means:* RRC parameter “*rach-LessHO*” is configured, or
* RRC pararmeter “*rach-lessHO*” is configured and at least one CG is considered to be valid.

According to the Q8a), we think it refers to the first case and the presence of the *rach-LessHO* IE triggers RACH-less HO **procedure**. So, we suggest to update the sentence into:*“when RACH-less handover procedure is triggered ~~and not terminated~~.”*Another option is to remove the ambiguity sentence, as the first sentence already mentions “for RACH-less handover”.*“For an uplink grant configured for configured grant Type 1 for RACH-less handover, ~~when RACH-less handover is triggered and not terminated,~~ for each configured uplink grant valid according to TS 38.214 [7] for which the above formula is satisfied, the MAC entity shall:* |
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## RACH-less HO and HARQ

### RACH-less HO and disabled HARQ feedback

[R2-2400871](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400871.zip) explains that the network knows whether the RACH-less handover is completed or not based on the HARQ feedback of the downlink assignment for the new transmission. In NTN, since the network can transmit the downlink assignment for new transmission using a HARQ process with HARQ feedback disabled, there is a case where the network does not know whether the RACH-less handover is completed or not, and this case may cause the handover failure due to T304 expiry. (companies are encouraged to refer to [R2-2400871](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400871.zip) for a detailed example).

Although the network can always transmit the downlink assignment for the new transmission using a HARQ process with HARQ feedback enabled for RACH-less handover completion, [R2-2400871](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400871.zip) notes this is inefficient for delay-sensitive service. [R2-2400871](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400871.zip) therefore proposes that it the network should be allowed to transmits the downlink assignment for the new transmission using a HARQ process with HARQ feedback disabled for RACH-less handover completion.

**Question 10a) Do you agree that for RACH-less handover completion, whether to use a HARQ process with HARQ feedback disabled or enabled for the downlink assignment of the new transmission is up to network implementation?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | Agree | Network has the full knowledge and it should be up to the network how to manage this. |
| Nokia | Agree | Concur Ericsson view |
| NEC | Agree |  |
| ZTE | Agree | Network generates the DL assignment if and only if the very first transmission is successfully received which denotes the arrival of the UE. After that, it can be up to the network to decide how to manage the subsequent DL assignment. |
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To indicate the RACH-less handover completion when the downlink assignment for the new transmission is transmitted using a HARQ process with HARQ feedback disabled, [R2-2400871](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400871.zip) proposes that during RACH-less handover, the UE transmits the HARQ feedback for a downlink assignment of a new transmission using the HARQ process with HARQ feedback disabled after transmitting the first uplink transmission. [R2-2400871](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400871.zip) notes this is a similar solution to Rel-17 when the UE transmits the HARQ feedback for the HARQ process with HARQ feedback disabled for the first transmission after activation of the configured downlink assignment if *HARQ-feedbackEnablingforSPSactive* is configured.

**Question 10b) Do you agree during RACH-less handover, the UE transmits the HARQ feedback for a downlink assignment of a new transmission using HARQ process with HARQ feedback disabled after transmitting the first uplink transmission?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | Disagree | We don’t see the need to have a specific behaviour for this. In principle it would be good to not over-optimize. |
| Nokia | Disagree | Concur Ericsson view |
| ZTE | Disagree | Further optimization is not needed. |
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### RV for transmission with configured grant

For the initial transmission of RACH-less handover in NTN, [R2-2400882](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400882.zip) mentions that RAN2 agreed and captured the autonomous retransmission by timer for the initial UL transmission with configured grant, however how to determine the RV of the autonomous retransmission is not specified. Considering that the re-transmission is autonomously performed by UE if initial transmission of RACH-less handover fails, the network is not aware of whether the transmission happens or not, therefore soft combination is not useful for autonomous re-transmission of the initial transmission of RACH-less handover procedure. From this point of view, [R2-2400882](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400882.zip) notes that applying different RV for repetitions of autonomous re-transmissions is not beneficial, then the RV 0 can be used for both initial transmission and its retransmission for RACH-less handover.

**Question 11) Do you agree to fix the RV to be 0 for both the initial transmission and its retransmission with configured grant for RACH-less handover?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | Tend to Disagree | We don’t see the need to have a specific behaviour for this. In principle it would be good to not over-optimize. |
| Nokia | Diasgree | Concur Ericsson view |
| NEC | Agree | At least how to determine the redundancy version for the initial uplink transmission and its retransmission with configured grant for RACH-less should be specified in specification, otherwise the UE is not clear about the RV used for encoding.For CG-SDT, how to determine the RV for first PUSCH transmission is specified as following:TS 38.213: For initial transmission or autonomous retransmission of an initial transport block provided for the PUSCH transmission as described in clause 18.0 in [19, TS 38.300], the UE encodes the transport block using redundancy version number 0 if the UE is not provided *repK-RV*.For RACH-less HO on CG, due to no repetition is introduced, we think the *repK-RV* should not be configured. And similar to CG-SDT, we think the RV 0 can be used for the initial uplink transmission and its retransmission with configured grant. This should be explicitly specified in specification. |
| ZTE | Disagree | Just follow the legacy behavior, further optimization is not needed. |
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### Retransmission of initial CG transmission on the same HARQ process

[R2-2401281](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2401281.zip) notes that in Rel-18, RAN2 introduced a CG RACH-less retransmission timer for NTN RACH-less handover and has agreed to support retransmission on the configured uplink grant resources for RACH-less. For legacy CG and CG-SDT, the retransmission for the initial CG/CG-SDT transmission with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS (see section 5.4.2.2 of TS 38.321), and [R2-2401281](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2401281.zip) understands that a similar principle should can also be applied to NTN RACH-less handover.

Rapporteur notes that a similar proposal was discussed during [POST124][312][NR-NTN-mIAB], where there was consensus support for this text to not be included.

**Question 12) Do you agree if *cg-RRC-RetransmissionTimer* is configured, retransmission for the initial CG-based RACH-less transmission with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS?**

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| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | Disagree |  |
| NEC | Disagree, see comments | For legacy CG and CG-SDT, multiple CG configurations can be supported.However, for RACH-less handover, it is not discuss whether the multiple CG is supported. The CG configured for RACH-less HO only used for the first PUSCH transmission, so we think single CG configuration is enough and it can avoid the resource waste compare to the multiple configrations.  |
| ZTE | See comments | The automatic reTX across the CG configuration is basically a feature of the NRU that is because the UE is able to select the HARQ process for each upcoming CG occasion no matter which CG configuration the CG occasion is from. It depends on whether we need to combine the RACH-less HO and NRU together. If the RACH-less HO can be performed on shared spectrum, we can support; In non-shared spectrum, the re-transmission only can be performed within the same CG configuration. |
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## RACH-less HO: Other identified issues

### Carrier selection for RACH-less handover

[R2-2400882](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400882.zip) notes that for RACH-less handover, the UE can access the target cell using configured grant if the *cg-RACH-Less-Configuration* is configured. Based on the ASN. 1 configuration, the configured grant can be configured on NUL or SUL, or on both carriers. However, it is unclear how UE determines the carrier used for the initial uplink transmission with configured grant during RACH-less handover procedure.

[R2-2400882](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400882.zip) further explains that for RACH-based handover, the UE selects the carrier to be used based on the explicitly signaling or based on the *rsrp-ThresholdSSB-SUL* threshold before the RACH resource selection. Similarly, for RACH-less handover, if the configured grant is configured, the UE should select the uplink carrier before the configured grant occasion for initial uplink transmission is selected. [R2-2400882](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400882.zip) proposes that the simplest way is to reuse the *rsrp-ThresholdSSB-SUL* threshold for carrier selection during the RACH-less handover procedure.

Rapporteur notes that additional considerations may be needed for at least the NTN scenario, since based on [AT124][301][NR-NTN Enh] it is unclear whether SUL is supported in NTN.

**Question 13) Do you agree that during the RACH-less handover procedure, if the configured grant is configured, reuse the *rsrp-ThresholdSSB-SUL* for carrier selection?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson |  | Our understanding is that this is already the case in current specification. Not sure what change is needed for this…and not sure if any restriction is needed. |
| Nokia |  | We think SUL is not supported in the NTN bands. So I doubt we can conclude NTN supports it. |
| NEC | Agree | Actually, this is not only related to NTN, the carrier selection procedure also should be defined for RACH-less HO for IAB. Since the correct UL carrier needs to be selected based on coverage, the carrier selection needs to happen before the initial uplink transmission. In current spec, the carrier selection procedure only specified for RACH procedure in section 5.1.1 and for CG-SDT procedure in section 5.27.1 of TS 38.321. For RACH-less HO procedure, we also need to specified this, otherwise the UE will not perform the carrier selection procedure during the RACH-less HO procedure. For example, it can be captured in section 5.33 RACH-less initial UL transmission:5.33 RACH-less initial UL transmission……When *rach-LessHO* is configured, the MAC entity shall:1> if *cg-RACH-less-Configuration* is configured:2>if the Serving Cell is configured with supplementary uplink as specified in TS 38.331 [5]; and2>if the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdSSB-SUL*:3> select the SUL carrier.2>else:3> select the NUL carrier.2> if the configured grant for RACH-less handover is configured on the selected carrier:3>select a configured uplink grant for initial uplink transmission according to clause 5.8.2;3>perform initial uplink transmission in the first available CG occasion for RACH-less handover according to clause 5.8.2. |
| ZTE | See comments | According to 38.331, for type1-CG, network cannot configure CG resources on both NUL and SUL, so, the UE uses the one that is configured. No need to discuss carrier selection.

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| ***configuredGrantConfig***A *Configured-Grant* of *type1* or *type2*. It may be configured for UL or SUL but in case of *type1* not for both at a time. Except for reconfiguration with sync, the NW does not reconfigure *configuredGrantConfig* when there is an active configured uplink grant Type 2 (see TS 38.321 [3]). However, the NW may release the *configuredGrantConfig* at any time. Network can only configure configured grant in one BWP using either this field or *configuredGrantConfigToAddModList.* |

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### TAT expiry during RACH-less HO

The NTN HO time is much longer than that of TN handover (up to 7.3 seconds based on RAN4 LS). [R2-2400939](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400939.zip) notes that in this HO scenario with long HO delay, if RACH-less HO is configured, it is very likely that TATimer will expire during the NTN HO procedure.

RAN2 agreed UE behavior upon TATimer expiry is same as legacy during RACH-less HO procedure, where upon TATimer expiry the UE will release UE dedicated SRS and PUCCH configuration. [R2-2400939](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400939.zip) explains that upon TATimer expiry during RACH-less HO, if UE releases dedicated PUCCH/SRS configuration in target cell which has not yet been applied, the network still needs to provide the same SRS and RRC configuration via a new RRCReconfiguration procedure after the HO successful completion.

[R2-2400939](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400939.zip) notes that this additional RRC signalling is really unnecessary and will also introduce more signaling burden, so proposes that it should be clarified that UE dedicated PUCCH and SRS configuration in target cell shall not be released upon TATimer expiry during the RACH-less HO.

**Question 14a) Do you agree to clarify that UE shall not release UE dedicated RRC configuration (i.e. SRS and PUCCH configuration) of target cell upon TATimer expiry during RACH-less HO?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
| Ericsson | Disagree | Network has the possibility to configure the TAT timer even to infinity for the case of NTN. Therefore, this clarification is unnecceary and create an unneccesary complexity in the specification. We should not over-optimize. |
| Nokia | Disagree | There is no guarantee that the after TATexpiry the handover will be successfully completed with fallback to RACH. Thus, the statement “the network still needs to provide the same SRS and RRC configuration” is not technically correct.The proposed optimisation would apply to any TATexpiry case we do not see why a new optimisation is introduced only for this use-case. |
| NEC | Disagree |  |
| ZTE | Disagree | Same view as Ericsson.  |
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[R2-2400939](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400939.zip) provides two possible alternatives to specify that UE dedicated PUCCH and SRS configuration in target cell shall not be released upon TATimer expiry during the RACH-less HO:

* **Alt 1: Capture it in MAC spec**: It is indicated in MAC spec that MAC doesnot notify RRC to release the PUCCH/SRS configuration during RAC-less HO.
* **Alt 2: Capture it in RRC spec**: It is indicated in RRC that RRC only releases the configuration which has been applied.

**Question 14b) If ‘Agree’ to Question 14a, should clarification that UE dedicated PUCCH and SRS configuration in target cell shall not be released upon TATimer expiry during the RACH-less HO be specified in MAC or RRC?**

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| **Company** | **MAC or RRC?** | **Additional comments**  |
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# Other corrections to RACH-less HO not included in contributions

**Question 15) Companies are invited to list any other identified issues with the RACH-less HO procedure in the ‘Additional comments’ section**

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| **Company** | **Additional comments**  |
| Nokia | 1. Replace the cg-NTN-RACH-Less-Configuration text with cg-RRC-RACH-Less-Configuration in section 5.3.5.3 of TS 38.331
2. The MAC and RRC specification is agnostic to RACH-less handover being NTN or mIAB related. A short text can be added to 38.300 to enable RACH-less handover for general intra-gNB scenarios.
 |
| ZTE | Since RAN2 agreed to extend RACH-less HO to normal L3 handover. We need to discuss whether ssbIndex or tci-StateID or both can be used in normal RACH-less handover? And update the below field description accordingly.

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| *RACH-LessHO* field descriptions |
| ***ssbIndex***This field indicates a beam that the UE should use in the target cell to monitor PDCCH for initial uplink transmission, see TS 38.321 [3]. This field is present when dynamic grant is used for initial uplink transmission in RACH-less handover in NTN. |
| ***targetNTA***This field refers to the timing adjustment, see TS 38.213 [13] and TS 38.321 [3], indicating the NTA value which the UE shall use for the target PTAG of handover. Only value *source* is configured by the network in case source cell is a mobile IAB cell. |
| ***tci-StateID***This field indicates a beam that the UE should use in the target cell to monitor PDCCH for initial uplink transmission. This field is present in case this cell is a mobile IAB cell. |

Currently, in TS 38.331, separate parameters are used to configure the CG configuration for LTM and other cases, and the definitions are the same. Although from MAC perspective, the handling of the two cases are different, from RRC signalling point of view, there is no need to use separate IEs, because they cannot be configured at the same time. (e.g. for LTM, the CG resources are configured in LTM candidate container). So, to aovid duplication, we suggest to merge them into one IE.  cg-LTM-Configuration-r18 CG-RRC-Configuration-r18 OPTIONAL, -- Cond LTM\*\*\*omitted\*\*\* cg-RRC-RACH-Less-Configuration-r18 CG-RRC-Configuration-r18 OPTIONAL -- Cond RACH-lessHO |
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# Conclusions

<To be generated based on company input>

# References

1. [R2-2400249](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400249.zip): [C604] [C622] On parameter applicability to CG RACH-less HO in NR NTN - CATT
2. [R2-2400803](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400803.zip): MAC corrections for NTN – InterDigital
3. [R2-2400810](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400810.zip): Corrections on NTN MAC issues - Samsung
4. [R2-2400869](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400869.zip): Discussion on configuration of ntn-cg-RACH-less-RetransmissionTimer - LG
5. [R2-2400871](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400871.zip): Indication for HARQ feedback for RACH-less handover - LG
6. [R2-2400882](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400882.zip): Discussion on remaining issues of RACH-less handover for NTN – NEC
7. [R2-2400939](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2400939.zip): Clarification on UE operation upon TATimer expiry during RACH-less HO - Apple
8. [R2-2401281](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_125/Docs/R2-2401281.zip): Discussion on MAC behaviours related to RACH-less HO and unchanged PCI - Huawei, HiSilicon