**3GPP TSG-RAN WG4 Meeting # 109 R4-231xxxx**

**Chicago, US, November 13 - 17, 2023**

**Agenda item:** 8.13.9

**Source:** Moderator (CMCC)

**Title:** Topic summary for [109][216] NR\_ATG

**Document for:** Information

# Introduction

This summary focuses on RRM core requirements maintenance and RRM performance requirements for Rel-18 NR ATG, including agenda 8.13.6 and 8.13.7. The agreed way forward in previous meetings are R4-2317341, R4-2314307, R4-2310159, R4-2306344, R4-2303226, R4-2220361, R4-2217256 and R4-2214347.

Recommendation of prioritized topics for online discussion

**Issue 1-1: ATG UE feature**

**Issue 1-3: UE specific koffset**

**Issue 2-1: TDD pattern**

**Issue 2-2: Channel model**

**Issue 2-3: Whether to define test cases for TCI switching delay requirements**

**Issue 2-5: UE mobility assumption**

**Issue 2-6: Test method for UE with antenna array**

**Issue 2-7: Neighbour cell configuration**

**Issue 2-10: Test scope**

# Topic #1: Core Maintenance

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318317 | CATT | Observation 1: The method of associating UE antenna architecture with bands will result in the following limitations: UE with other antenna architecture will not be able to use band n79, and UE with [antenna arrays] will only be able to use band n79.  Proposal 1: Define a UE capability to differentiate UE with [omnidirectional antennas] and UE with [antenna arrays].  Proposal 2: If additional UE capability is needed, RAN4 should send a LS to RAN2 for designing new UE capability. |
| R4-2318318 | CATT | CR on L3 measurement procedure requirements for ATG |
| R4-2318900 | CMCC | Big CR to TS 38.133 on Air-to-ground network for NR |
| R4-2318901 | CMCC | Proposal 1: Introduce the ATG UE feature of uplink time and frequency pre-compensation and timing relationship enhancements as follows:   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional | | Uplink Time and Frequency pre-compensation and timing relationship enhancements | Support of UE specific TA calculation based on its GNSS-acquired position and the indicated BS location.  For TA update in RRC\_CONNECTED state, support of combination of both open (i.e. UE autonomous TA estimation) and closed (i.e., received TA commands) control loops.  Support of pre-compensation of the calculated TA in its uplink transmissions  Support of frequency pre-compensation to counter shift the Doppler experienced on the service link.  Support of determining timing of the scheduling of PUSCH, PUCCH and PDCCH ordered PRACH, CSI reference resource, transmission of aperiodic SRS activation of TA command, first PUSCH transmission in CG Type 2 with cell-specific K\_offset if indicated.  Support of UE receiving cell-specific K\_offset in system information. |  | TBD | BandNR | No | No | An ATG UE is required to at least support UE specific TA and frequency calculation based at least on its GNSS-acquired position and the indicated BS location  Note: This UE feature group is applicable only for ATG operating bands | Optional with capability signalling  For UE supports NR communication via ATG, UE must indicate this FG is supported. |   Proposal 2: Introduce the ATG UE feature of UE reporting of TA information and UE-specific K\_offset as follows:   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional | | UE reporting of TA information | Support UE reporting of TA information | TBD  [Uplink Time and Frequency pre-compensation and timing relationship enhancements] | TBD | BandNR | No | No | Note 1: The exact content of UE reporting of information about the TA pre-compensation is up to RAN2  Note 2: This UE feature group is applicable only for ATG operating bands | Optional with capability signalling | | UE-specific K\_offset | Support of reception of UE-specific K\_offset via MAC-CE.  Support of determining the timing of PUSCH, PUCCH, CSI reference resource, transmission of aperiodic SRS, activation of TA command, first PUSCH transmission in CG Type 2 with UE-specific Koffset | TBD  [Uplink Time and Frequency pre-compensation and timing relationship enhancements  And  UE reporting of TA information] | TBD | BandNR | No | No | Note: This UE feature group is applicable only for ATG operating bands | Optional with capability signalling |   Proposal 3: Introduce the ATG UE features of Increasing the number of HARQ processes and K1 range extension as follows:   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional | | Increasing the number of HARQ processes | The maximal supported HARQ process number is X for UL and Y for DL |  | TBD | BandNR | No | No | Candidate component values for (X,Y): {(16,32),(32,16),(32,32)}  Note: This UE feature group is applicable only for ATG operating bands | Optional with capability signalling | | K1 range extension | Support of extended K1 value range of (0..31) for unpaired spectrum |  | TBD | BandNR | No | No | Note: This UE feature group is applicable only for ATG operating bands | Optional with capability signalling |   Proposal 4: Introduce the ATG UE feature of Location based CHO, Event A4 based CHO and Location-based measurement report trigger as follows:   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional | | Location based CHO | Indicates whether the UE supports location based CHO | condHandover-r16 is set for ATG bands. | TBD | BandNR | No | No | UE shall set the capability value consistently for all ATG operating bands. | Optional with capability signalling | | Event A4 based CHO | Indicates whether the UE supports Event A4 based CHO | condHandover-r16 is set for ATG bands. | TBD | BandNR | No | No | UE shall set the capability value consistently for all ATG operating bands. | Optional with capability signalling | | Location-based measurement report trigger | Indicates whether the UE supports location-based triggered measurement reporting (i.e., event D1) | TBD  [Location based CHO] | TBD | MeasAndMobParametersCommon | No | No |  | Optional with capability signalling |   Proposal 5: Introduce the ATG UE feature of SR triggered by a TA report and TA reporting during initial access as follows:   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional | | SR triggered by a TA report | Indicates whether the UE supports triggering of SR when a TA report is triggered and there are no available UL-SCH resources. |  | TBD | MAC-ParametersCommon | No | No |  | Optional with capability signalling | | TA reporting during initial access | It is mandatory to support TA reporting during initial access for UEs supporting [uplink-TA-Reporting-r17] as specified in TS 38.321 [10]. |  | n/a | n/a | n/a | n/a |  | Conditional mandatory without capability signalling |   Proposal 6: Introduce the ATG UE feature of Enhanced RRM requirements for measurements in IDLE and INACTIVE modes as follows:   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional | | Enhanced RRM requirements for measurements in IDLE and INACTIVE modes | Indicate the support of enhanced inter-frequency cell re-selection requirements for ATG (as specific in TS 38.133 Table 4.2D.2.4-2) |  | n/a | n/a | No | No |  | Optional without capability signaling |   Observation 1: In RAN4#108bis, RF session has agreed to introduce new capability of ATG UE to support different requirements. |
| R4-2318902 | CMCC | TP to TR 38.876: RRM requirements for ATG network |
| R4-2318903 | CMCC | Proposal 1: The koffset mechanism as R17 NTN including both cell-specific koffset and UE-specific koffset should be supported in R18 ATG.  Proposal 2: The maximum value of cell-specific koffset is 3ms in ATG scenario, which should be covered by the signalling of cell-specific koffset in ATG SIB. |
| R4-2319151 | Ericsson | CR on measurement requirement in ATG |
| R4-2320146 | Ericsson | Corrections to the ATG IDLE/CONNECTED mode mobility requirements |

## Open issues summary

**Issue 1-1: ATG UE feature**

* Proposals
  + Option 1: Introduce following ATG UE features: (CMCC)
    - L1 features:

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| Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| Uplink Time and Frequency pre-compensation and timing relationship enhancements | Support of UE specific TA calculation based on its GNSS-acquired position and the indicated BS location.  For TA update in RRC\_CONNECTED state, support of combination of both open (i.e. UE autonomous TA estimation) and closed (i.e., received TA commands) control loops.  Support of pre-compensation of the calculated TA in its uplink transmissions  Support of frequency pre-compensation to counter shift the Doppler experienced on the service link.  Support of determining timing of the scheduling of PUSCH, PUCCH and PDCCH ordered PRACH, CSI reference resource, transmission of aperiodic SRS activation of TA command, first PUSCH transmission in CG Type 2 with cell-specific K\_offset if indicated.  Support of UE receiving cell-specific K\_offset in system information. |  | TBD | BandNR | No | No | An ATG UE is required to at least support UE specific TA and frequency calculation based at least on its GNSS-acquired position and the indicated BS location  Note: This UE feature group is applicable only for ATG operating bands | Optional with capability signalling  For UE supports NR communication via ATG, UE must indicate this FG is supported. |

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| Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| UE reporting of TA information | Support UE reporting of TA information | TBD  [Uplink Time and Frequency pre-compensation and timing relationship enhancements] | TBD | BandNR | No | No | Note 1: The exact content of UE reporting of information about the TA pre-compensation is up to RAN2  Note 2: This UE feature group is applicable only for ATG operating bands | Optional with capability signalling |
| UE-specific K\_offset | Support of reception of UE-specific K\_offset via MAC-CE.  Support of determining the timing of PUSCH, PUCCH, CSI reference resource, transmission of aperiodic SRS, activation of TA command, first PUSCH transmission in CG Type 2 with UE-specific Koffset | TBD  [Uplink Time and Frequency pre-compensation and timing relationship enhancements  And  UE reporting of TA information] | TBD | BandNR | No | No | Note: This UE feature group is applicable only for ATG operating bands | Optional with capability signalling |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| Increasing the number of HARQ processes | The maximal supported HARQ process number is X for UL and Y for DL |  | TBD | BandNR | No | No | Candidate component values for (X,Y): {(16,32),(32,16),(32,32)}  Note: This UE feature group is applicable only for ATG operating bands | Optional with capability signalling |
| K1 range extension | Support of extended K1 value range of (0..31) for unpaired spectrum |  | TBD | BandNR | No | No | Note: This UE feature group is applicable only for ATG operating bands | Optional with capability signalling |

* + - L2/3 features

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| Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| Location based CHO | Indicates whether the UE supports location based CHO | condHandover-r16 is set for ATG bands. | TBD | BandNR | No | No | UE shall set the capability value consistently for all ATG operating bands. | Optional with capability signalling |
| Event A4 based CHO | Indicates whether the UE supports Event A4 based CHO | condHandover-r16 is set for ATG bands. | TBD | BandNR | No | No | UE shall set the capability value consistently for all ATG operating bands. | Optional with capability signalling |
| Location-based measurement report trigger | Indicates whether the UE supports location-based triggered measurement reporting (i.e., event D1) | TBD  [Location based CHO] | TBD | MeasAndMobParametersCommon | No | No |  | Optional with capability signalling |

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| Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| SR triggered by a TA report | Indicates whether the UE supports triggering of SR when a TA report is triggered and there are no available UL-SCH resources. |  | TBD | MAC-ParametersCommon | No | No |  | Optional with capability signalling |
| TA reporting during initial access | It is mandatory to support TA reporting during initial access for UEs supporting uplink-TA-Reporting-r17 as specified in TS 38.321 [10]. |  | n/a | n/a | n/a | n/a |  | Conditional mandatory without capability signalling |

* + - RRM features

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| Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| Enhanced RRM requirements for measurements in IDLE and INACTIVE modes | Indicate the support of enhanced inter-frequency cell re-selection requirements for ATG (as specific in TS 38.133 Table 4.2D.2.4-2) |  | n/a | n/a | No | No |  | Optional without capability signaling |

* Recommended WF
  + To be discussed
  + For Layer-1/2/3 UE features, LS need to be sent to RAN1/2

**Issue 1-2: UE capability for ATG UEs with antenna arrays and omnidirectional antennas**

* Proposals
  + Option 1: Define a UE capability to differentiate UE with [omnidirectional antennas] and UE with [antenna arrays]. (CATT)
* Recommended WF
  + No need to be discussed.
    - In RAN4#108bis, RF session has agreed to introduce new capability of ATG UE to support different requirements. LS has been sent to RAN2 (R4-2317742)

**Issue 1-3: UE specific koffset**

* Proposals
  + Option 1: The koffset mechanism as R17 NTN including both cell-specific koffset and UE-specific koffset should be supported in R18 ATG.
  + Option 2: The maximum value of cell-specific koffset is 3ms in ATG scenario, which should be covered by the signalling of cell-specific koffset in ATG SIB.
* Recommended WF
  + The koffset mechanism as R17 NTN including both cell-specific koffset and UE-specific koffset should be supported in R18 ATG.
  + The maximum value of cell-specific koffset (unit: slot of 15kHz SCS) should cover 3ms (3 slots) in ATG scenario

# Topic #2: ATG RRM performance requirements

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318319 | CATT | Proposal 1: Redesigning an OTA test methodology for FR1 ATG UE with [antenna arrays] is too complex, and we are currently not clear about how to design the relevant details.  •Open to further discuss the feasibility of OTA test.  Proposal 2: The approach of only to introduce the scaling factor in the RRM core requirement and not to have the scaling factor in the tests is more simpler and cheaper.  Proposal 3: If ATG UE is tested with conducted test, even if the scaling factor is introduced in test requirement for UE with [antenna arrays], the actual results of the conducted test will not reflect any differences, which seems to be a redundant test.  Proposal 4: The UE mobility should be assumed with 1200km/h at least for and location-based CHO and UL transmit timing tests.  Proposal 5: Use the AWGN with residual doppler channel model for RRM test cases. |
| R4-2318904 | CMCC | Proposal 1: Reuse the legacy TDD pattern which specified in Table A.3.1.4-2 in TS 38.133.  Proposal 2: Use the AWGN with residual doppler channel model for RRM test cases.  Proposal 3: Don’t define the test cases for TCI switching delay requirements.  Proposal 4: GNSS is viable via AT command for all test cases  Proposal 5: GNSS is changing during the test cases of location-based CHO and UL transmit timing, the UE mobility should be assumed with 1200km/h. For the other tests, UE could be assumed with no mobility.  Proposal 6: Conducted test should be reused for ATG UE with antenna array, the scaling factor need to be considered in the test requirements.  Proposal 7: For the TDD cell re-selection test and and intra/inter-frequency measurement test for UE with antenna array, choose some test cases to configure 2 neighbour cells.  Proposal 8: All the tests listed in last meeting’s agreement should be applied for ATG UE. |
| R4-2319254 | LG Electronics | Proposal 1: Consdier ‘30D4S6U’ as TDD UL/DL pattern  Proposal 2: Consider conducted test for UE with antenna array, and beam sweeping factor should be considered in the test requirements. |
| R4-2319366 | Huawei, HiSilicon | Observation 1: Conducted test is possible for UE with antenna array.  Proposal 1: Define conducted test case for UE with antenna array and the scaling factor is considered in the test requirements.  Proposal 2: GNSS is available via AT command for all test cases, and GNSS only changed during the test for location-based CHO.  Proposal 3: Do not define test case for TCI state switching for ATG UE. |
| R4-2320129 | Ericsson | Proposal 1: RAN4 to discuss additional test cases considering the new TDD pattern for ATG (if agreed).  Proposal 2: The legacy NR RMCs defined in section A.3.1 of TS 38.133 are reused for ATG test cases.  Proposal 3: Following legacy NR OCNGs are reused for ATG test cases:  -Generic OCNG pattern for all unused REs defined in A.3.2.1.1 in TS 38.133.  -Generic OCNG pattern for unused REs in the same bandwidth as CORESET defined in A.3.2.1.3 of TS 38.133.  -Generic OCNG pattern for all unused REs outside SSB slot(s) defined in A.3.2.1.4 in TS 38.133  Proposal 4: RAN4 to define tests to verify the TCI state switching delay requirements for ATG UEs not supporting antenna arrays. FFS whether to define similar tests for ATG UEs supporting antenna arrays.  Proposal 5: AWGN with Doppler shift is used as the channel model for defining the ATG RRM test cases.  Proposal 6: RAN4 to consult RAN5 feedback on whether it is feasibility to define test cases for ATG UEs in FR1 with beamsweeping capability.  Proposal 7: GNSS is viable via AT command for all test cases, and GNSS only changed during the test for location-based CHO.  Proposal 8: For neighbour cell configurations for FDD cell reselection test cases for both intra- and inter-frequency NR case for ATG UE with antenna array, configure 1 neighbour cell.  Proposal 9: For neighbour cell configurations for TDD cell reselection test cases for both intra- and inter-frequency NR case for ATG UE with antenna array, choose some test cases to configure 2 neighbour cells.  Proposal 10: UE speed in RRM mobilty test cases are modelled using the Doppler shift, i.e. no need to consider UE speed explicitly.  Proposal 11: Test case list presented in R4-2317341 is adopted for ATG performance requirements with following changes:  oOnly non-DRX mode tests are defined in CONNECTED mode.  oFor HO: only inter-frequency handover with unknown target cell is defined.  oFor RRC re-establishment, following tests are defined:  Intra-frequency RRC Re-establishment with known target cell  Inter-frequency RRC Re-establishment with unknown target cell  Proposal 12: Test case list presented in R4-2317341 is adopted for ATG performance requirements.  Proposal 13: ATG tests are defined in separate clauses:  oIf core requirements are identical to corresponding legacy tests, references are used to point to the existing tests.  oModifed/delta tests parameters specific ATG to replace corresponding tests parameters in the legacy tests. |
| R4-2320418 | ZTE Corporation | Proposal 1: Two alternatives for the test method with antenna array assumption:  Alternative 1: Define OTA test to verify beam sweeping for ATG UE with phase antenna array capability.  Alternative 2: Not to distinguish the test between conductive test and OTA test, only focus on the requirements of delay. Leave the test details to actual implementation.  Proposal 2: Test cases can be designed for MAC CE based and DCI based TCI state switching.  Observation 1: In R17 NTN testing, the GNSS change is only considered in the test case of location based cell reselection to intra-frequency cell, and the GNSS change is no less than distanceThresh plus 50m.  Proposal 3: GNSS is viable via AT command for all test cases, and GNSS only changed during the test for location-based CHO.  Proposal 4: The GNSS change should be set with the consideration of two distance threshold istanceThreshFromReference1 and distanceThreshFromReference2, e.g. max{distanceThreshFromReference1,distanceThreshFromReference2}+50m.  Proposal 5: Use the AWGN with residual doppler channel model for RRM test cases.  Proposal 6: Define a new TDD configuration with the pattern of ‘30D4S6U’ for ATG UE.  Proposal 7: Take the test cases listed in the WF of last meeting as baseline. |

## Open issue summary

**Issue 2-1: TDD pattern**

* Proposals
  + Option 1: Reuse the legacy TDD pattern which specified in Table A.3.1.4-2 in TS 38.133. (CMCC)
  + Option 2: Define a new TDD configuration with the pattern of ‘30D4S6U’ for ATG UE. (LGE, Ericsson, ZTE)
* Recommended WF
  + The legacy TDD pattern are used as baseline TDD pattern for all ATG test cases.
  + In Section A.3.1.4, define a new TDD configuration with the pattern of ‘30D4S6U’ for ATG UE.
  + Introduce the new TDD pattern ‘30D4S6U’ in one or more ATG test cases. FFS which test cases.
  + The new TDD pattern configuration only applies to UE supporting relevant UE capability.
  + If UE pass the test cases with new TDD pattern, the same test cases with legacy TDD pattern can be passed.

**Issue 2-2: Channel model**

* Proposals
  + Option 1: Use the AWGN with **residual** doppler channel model for RRM test cases. (CMCC, CATT, ZTE)
  + Option 2: AWGN with Doppler shift is used as the channel model for defining the ATG RRM test cases. (Ericsson)
* Recommended WF
  + Check whether Option 1 can be agreed.

**Issue 2-3: Whether to define test cases for TCI switching delay requirements**

* Proposals
  + Option 1: Do not define test case for TCI state switching for ATG UE. (HW, CMCC)
  + Option 2: RAN4 to define tests to verify the TCI state switching delay requirements for ATG UEs not supporting antenna arrays. FFS whether to define similar tests for ATG UEs supporting antenna arrays. (Ericsson)
  + Option 3: Test cases can be designed for MAC CE based and DCI based TCI state switching. (ZTE)
* Recommended WF
  + Encourage the proponents of Option 2/3 to provide more details of test cases. For example, how to differentiate the TCI state switching.

**Issue 2-4: GNSS setup**

* Proposals
  + Option 1: GNSS is viable via AT command for all test cases (CMCC, HW, Ericsson, ZTE)
* Recommended WF
  + Option 1 can be agreed.

**Issue 2-5: UE mobility assumption**

* Proposals
  + Option 1: GNSS is changing during the test cases of location-based CHO and UL transmit timing, the UE mobility should be assumed with 1200km/h. For the other tests, UE could be assumed with no mobility (CATT, CMCC)
  + Option 2: GNSS only changed during the test for location-based CHO. (HW, Ericsson, ZTE)
  + Option 3: UE speed in RRM mobilty test cases are modelled using the Doppler shift, i.e. no need to consider UE speed explicitly. (Ericsson)
  + Option 4: The GNSS change should be set with the consideration of two distance threshold istanceThreshFromReference1 and distanceThreshFromReference2, e.g. max{distanceThreshFromReference1,distanceThreshFromReference2}+50m. (ZTE)
* Recommended WF
  + GNSS changed during the test for location-based CHO.
  + FFS whether GNSS changed or not during the UL transmit timing test
  + FFS how to set the GNSS change,
    - Option 1: 1200km/h.
    - Option 2: modeled using the Doppler shift
    - Option 3: The GNSS change should be set with the consideration of two distance threshold istanceThreshFromReference1 and distanceThreshFromReference2, e.g. max{distanceThreshFromReference1,distanceThreshFromReference2}+50m.

**Issue 2-6: Test method for UE with antenna array**

* Proposals
  + Option 1: The approach of only to introduce the scaling factor in the RRM core requirement and not to have the scaling factor in the tests is more simpler and cheaper. (CATT)
  + Option 2: Conducted test should be reused for ATG UE with antenna array, the scaling factor need to be considered in the test requirements. (CMCC, LGE, HW)
  + Option 3: RAN4 to consult RAN5 feedback on whether it is feasibility to define test cases for ATG UEs in FR1 with beam sweeping capability. (Ericsson)
  + Option 4: Two alternatives for the test method with antenna array assumption: (ZTE)
    - Alternative 1: Define OTA test to verify beam sweeping for ATG UE with phase antenna array capability. (CATT open to discuss the feasibility)
    - Alternative 2: Not to distinguish the test between conductive test and OTA test, only focus on the requirements of delay. Leave the test details to actual implementation.
* Recommended WF
  + To be discussed

**Issue 2-7: Neighbour cell configuration**

* Proposals
  + Option 1: For the TDD cell re-selection test and and intra/inter-frequency measurement test for UE with antenna array, choose some test cases to configure 2 neighbour cells. (CMCC, Ericsson)
* Recommended WF
  + To be discussed

**Issue 2-8: RMC**

* Proposals
  + Option 1: The legacy NR RMCs defined in section A.3.1 of TS 38.133 are reused for ATG test cases. (Ericsson)
* Recommended WF
  + Option 1 can be agreed.

**Issue 2-9: OCNG**

* Proposals
  + Option 1: Following legacy NR OCNGs are reused for ATG test cases:
    - Generic OCNG pattern for all unused REs defined in A.3.2.1.1 in TS 38.133.
    - Generic OCNG pattern for unused REs in the same bandwidth as CORESET defined in A.3.2.1.3 of TS 38.133.
    - Generic OCNG pattern for all unused REs outside SSB slot(s) defined in A.3.2.1.4 in TS 38.133
* Recommended WF
  + Option 1 can be agreed.

**Issue 2-10: Test scope**

* Proposals
  + Option 1: All the tests listed in last meeting’s agreement should be applied for ATG UE. (CMCC, ZTE)
  + Option 2: Test case list presented in R4-2317341 is adopted for ATG performance requirements with following changes: (Ericsson)
    - Only non-DRX mode tests are defined in CONNECTED mode.
    - For HO: only inter-frequency handover with unknown target cell is defined.
    - For RRC re-establishment, following tests are defined:
      * Intra-frequency RRC Re-establishment with known target cell
      * Inter-frequency RRC Re-establishment with unknown target cell
* Recommended WF
  + Only non-DRX mode tests are defined in CONNECTED mode (agreed in last meeting)
  + For other sub-bullets in Option2, to be discussed
  + The tests listed in last meeting’s agreement:

|  |  |
| --- | --- |
| **Test scope**  **RRC\_IDLE state mobility** | **Test number** |
|
| Cell reselection to intra-frequency neighbour cell | ATG 1-1 |
| Location based cell reselection to intra-frequency neighbour cell | ATG 1-2 |
| Cell reselection to inter-frequency neighbour cell | ATG 1-3 |
| Cell reselection to inter-frequency NR cell for UE configured with [enhanced requirements] | ATG 1-4 |
| Location based cell reselection to inter-frequency neighbour cell | ATG 1-5 |

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| **Test scope**  **RRC\_CONNECTED state mobility** | **Test number** |
|
| Intra-frequency HO with known target cell | ATG 2-1 |
| Intra-frequency HO with unknown target cell | ATG 2-2 |
| Inter-frequency HO with known target cell | ATG 2-3 |
| Inter-frequency HO with unknown target cell | ATG 2-4 |
| Intra-frequency location based CHO | ATG 2-5 |
| Inter-frequency location based CHO | ATG 2-6 |
| Intra-frequency RRC Re-establishment with known target cell | ATG 2-7 |
| Intra-frequency RRC Re-establishment with unknown target cell | ATG 2-8 |
| Inter-frequency RRC Re-establishment with known target cell | ATG 2-9 |
| Inter-frequency RRC Re-establishment with unknown target cell | ATG 2-10 |
| Inter-frequency RRC Re-establishment in FR1 without serving cell timing | ATG 2-11 |
| 4-step RA type contention based random access test | ATG 2-12 |
| 4-step RA type Non-Contention based random access test | ATG 2-13 |
| 2-step RA type contention based random access test | ATG 2-14 |
| 2-step RA type Non-Contention based random access test | ATG 2-15 |
| RRC Connection Release with Redirection | ATG 2-16 |

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| **Test scope**  **Timing** | **Test number** |
|
| UE transmit timing test | ATG 3-1 |
| Timing advance adjustment delay and accuracy | ATG 3-2 |

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| **Test scope**  **Signalling characteristics** | **Test number** |
|
| Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with SSB-based RLM RS in non-DRX mode | ATG 4-1 |
| Radio Link Monitoring In-sync Test for FR1 PCell configured with SSB-based RLM RS in non-DRX mode | ATG 4-2 |
| Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with CSI-RS-based RLM in non-DRX mode | ATG 4-3 |
| Radio Link Monitoring In-sync Test for FR1 PCell configured with CSI-RS-based RLM in non-DRX mode | ATG 4-4 |
| Beam Failure Detection and Link Recovery Test for FR1 PCell configured with SSB-based BFD and LR in non-DRX mode | ATG 4-5 |
| Beam Failure Detection and Link Recovery Test for FR1 PCell configured with CSI-RS-based BFD and LR in non-DRX mode | ATG 4-6 |
| DCI-based and Timer-based Active BWP Switch | ATG 4-7 |
| RRC-based Active BWP Switch | ATG 4-8 |
| UE specific CBW change | ATG 4-9 |
| Pathloss reference signal switching delay | ATG 4-10 |

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| **Test scope**  **Measurement procedure** | **Test number** |
|
| Intra-frequency measurements event triggered reporting tests without gap under non-DRX | ATG 5-1 |
| Intra-frequency measurements event triggered reporting tests with per-UE gaps under non-DRX | ATG 5-2 |
| Intra-frequency measurements event triggered reporting tests without gap under non-DRX with SSB index reading | ATG 5-3 |
| Intra-frequency measurements SA event triggered reporting tests with per-UE gaps under non-DRX with SSB index reading | ATG 5-4 |
| Inter-frequency measurements event triggered reporting tests for FR1 without SSB time index detection when DRX is not used | ATG 5-5 |
| Inter-frequency measurements event triggered reporting tests for FR1 with SSB time index detection when DRX is not used | ATG 5-6 |
| Inter-frequency measurements event triggered reporting tests for FR1 without gap when DRX is not used | ATG 5-7 |
| SSB based L1-RSRP measurement when DRX is not used | ATG 5-8 |
| CSI-RS based L1-RSRP measurement when DRX is not used | ATG 5-9 |
| L1-SINR measurement with CSI-RS based CMR and no dedicated IMR configured when DRX is not used | ATG 5-10 |
| L1-SINR measurement with SSB based CMR and dedicated IMR when DRX is not used | ATG 5-11 |
| L1-SINR measurement with CSI-RS based CMR and dedicated IMR configured when DRX is not used | ATG 5-12 |
| SA intra-frequency CGI identification of NR neighbor cell in FR1 | ATG 5-13 |

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| **Test scope**  **Measurement Performance requirements** | **Test number** |
|
| SS-RSRP intra-frequency case measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-1 |
| SS-RSRP inter-frequency case measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-2 |
| SS-RSRQ intra-frequency case measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-3 |
| SS-RSRQ inter-frequency case measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-4 |
| SS-SINR intra-frequency case measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-5 |
| SS-SINR inter-frequency case measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-6 |
| L1-RSRP measurement SSB based L1-RSRP measurement | ATG 6-7 |
| L1-RSRP measurement CSI-RS based L1-RSRP measurement on resource set with repetition off | ATG 6-8 |
| L1-SINR measurement with CSI-RS based CMR and no dedicated IMR configured and CSI-RS resource set with repetition off | ATG 6-9 |
| L1-SINR measurement with SSB based CMR and dedicated IMR | ATG 6-10 |
| L1-SINR measurement with CSI-RS based CMR and dedicated IMR | ATG 6-11 |
| CSI-RSRP intra-frequency case measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-12 |
| CSI-RSRP inter-frequency case measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-13 |
| CSI-RSRQ Intra-frequency measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-14 |
| CSI-RSRQ Inter-frequency measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-15 |
| CSI-SINR intra-frequency measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-16 |
| CSI-SINR Inter-frequency measurement accuracy with FR1 serving cell and FR1 target cell | ATG 6-17 |

# Topic #3: CR and TP

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318318 | CATT | CR on L3 measurement procedure requirements for ATG |
| R4-2318900 | CMCC | Big CR to TS 38.133 on Air-to-ground network for NR |
| R4-2318902 | CMCC | TP to TR 38.876: RRM requirements for ATG network |
| R4-2319151 | Ericsson | CR on measurement requirement in ATG |
| R4-2320146 | Ericsson | Corrections to the ATG IDLE/CONNECTED mode mobility requirements |

## Open issues summary

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| **T-doc number** | **Company** | **Proposals / Observations** | **Recommended WF** |
| R4-2318318 | CATT | CR on L3 measurement procedure requirements for ATG | Merged to R4-2319151 |
| R4-2318900 | CMCC | Big CR to TS 38.133 on Air-to-ground network for NR | Approved in RAN4#108bis post-meeting |
| R4-2318902 | CMCC | TP to TR 38.876: RRM requirements for ATG network | Can be agreed. |
| R4-2319151 | Ericsson | CR on measurement requirement in ATG | Collect comments  Moderator: MCC suggest to add ‘void’ to fix the numbering uncontinuous error. |
| R4-2320146 | Ericsson | Corrections to the ATG IDLE/CONNECTED mode mobility requirements | Check the change 1: The flag to inform the UE about which type of cell detection requirements apply for inter-frequency cell reselections is updated. |