**3GPP TSG-RAN WG4 Meeting # 112 R4-24XXXXX**

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

**Agenda item:** 8.10.5

**Source:** Moderator (CMCC)

**Title:** Topic summary for [112][217] NR\_ATG\_enh

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion (e.g. list of treated agenda items) and provide some guidelines for email discussion if necessary.*

This summary focuses on RRM core requirements for Rel-19 NR ATG enh, including agenda 8.10.4.

Recommendation of prioritized topics for online discussion

**Issue 1-1-1: Scenario**

**Issue 1-1-4: Whether to support multiple downlink SCells**

**Issue 1-1-5: UE antenna type**

**Issue 1-1-2: Co-located definition**

**Issue 1-3-1: MTTD**

**Issue 1-3-2: MRTD**

**Issue 1-5-2: CSSF**

**Issue 1-2-1: Cell re-selection Idle/Inactive mode CA measurements**

**Issue 1-2-2: Idle/Inactive mode CA measurements (R16)/Issue 1-2-3: Measurement report for fast CA/DC setup (R18)**

# Topic #1: RRM core requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411353 | CATT | Proposal 1: CA related RRM requirements will be applicable to R19 ATG, which only consider FR1 intra-band contiguous CA and FR1+FR1 inter-band CA.Proposal 2: Considering the new CA scenario in R19 ATG, the proposed RRM requirements need to be updated or specified, as shown in Table 1.Proposal 3: For the specification structure of R19 ATG RRM requirements in TS 38.133, the CA related requirements can be directly added in the sections defined for R18 ATG UE.Proposal 4: The requirements of idle/inactive mode CA measurements (clauses 4.4 and 5.4 in TS 38.133) should be defined for ATG UE in Rel-19.RAN4 to consider whether to define the requirements of measurement report for fast CA setup in idle/inactive mode for R19 ATG UE.Proposal 5: The FR1 related requirements of MTTD and MRTD for Carrier Aggregation (clauses 7.5.4 and 7.6.4 in TS 38.133) should be introduced for ATG UE.Proposal 6: The FR1 related requirements of interruptions on PCell and activated SCell with Standalone NR Carrier Aggregation (clause 8.2.2 in TS 38.133) should be introduced for ATG UE.Proposal 7: The FR1 related requirements of SCell Activation and Deactivation Delay (clause 8.3 in TS 38.133) for standalone NR carrier aggregation should be introduced for ATG UE. |
| R4-2411423 | Apple |

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| --- | --- | --- |
| **Sub-clause** | **Requirement** | **Comments** |
| **3** | **Definitions, symbols and abbreviations** |
| **3.5** | Frequency band grouping |  |
| **3.6** | Applicability of requirements |  |
| **4** | **RRC\_IDLE state mobility** |
| **4.1** | Cell Selection |  |
| **4.2** | Cell Res-election |  |
| **4.3** | Minimization of Drive tests (MDT) |  |
| **4.4** | Idle Mode CA/DC measurement | This feature is intended for fast CA/DC establishment after RRC connection setup. Regarding ATG, it is intended for in-flight eMBB service. There is little chance for ATG UE to go to RRC\_IDLE mode since we can assume that there is always data connection demand from some passengers. It’s hard to see that all passengers go to seep even in red-eye flight. We think this feature has little meaning for ATG UE. But if there is interest to keep this for ATG, it’s also fine since there is no additional effort and requirement can be reused directly. |
| **5** | **RRC\_INACTIVE state mobility** |
| **5.1** | Cell Re-selection |  |
| **5.3** | Minimizaiton of Drive Test (MDT) |  |
| **5.4** | Idle Mode CA/DC Measurement | Same analysis as for Idle Mode CA/DC measurement in section 4.4. this feature has meaningless for ATG UE.But if there is interest to keep this for ATG, it’s also fine since there is no additional effort and requirement can be reused directly. |
| **5.5** | Configured Grant based small date transitions |  |
| **5.6** | NR measurements for positioning |  |
| **6** | **RRC\_CONNECTED state mobility** |
| **6.1** | Handover |  |
| **6.2** | RRC Connection Mobility Control |  |
| **7** | **Timing** |
| **7.1** | UE transmit timing |  |
| **7.2** | UE timer accuracy |  |
| **7.3** | Timing advanced |  |
|  |  |  |
| **7.4** | Cell phase synchronization |  |
| **7.5** | Maximum Transmission Timing Difference | In section 7.5.4, MTTD requirement is only specified for inter-band CA and intra-band non-contiguous CA for non-collocated scenario. For ATG UE, only collocated scenario is considered for both intra-band contiguous CA\_n79C and inter-band CA\_n3-n39. It is suggested that RAN4 discuss whether MTTD requirement for collocated scenario is needed for ATG supporting intra-band contiguous CA and inter-band CA. |
| **7.6** | Maximum Receiving Time Difference | In section 7.6.4, MRTD requirement is specified for intra-band non-contiguous CA for collocated scenario only and for inter-band CA for non-collocated scenario. It is suggested that RAN4 discuss whether MRTD requirement for collocated scenario need to be specified for intra-band contiguous CA and inter-band CA. |
| **7.7** | deriveSSB-IndexFromCell tolerance |  |
| **7.9** | *deriveSSB-IndexFromCell* tolerance |  |
| **8** | **Signaling characteristics** |
| **8.1** | Radio link monitoring |  |
| **8.2** | Interruption |  |
| **8.2.2** | Introduction | Some adaption on the requirement applicability is needed depending on the supported feature by ATG UE. |
| **8.2.2.2.1** | Interruption at Scell addition/release | The requirement can be reused by focusing on the applicable part for ATG by considering the same corresponding scenario. FR2 and FR1 non-collocated part should be deleted. |
| **8.2.2.2.2** | Interruptions at SCell activation/deactivation | The requirement can be reused by focusing on the applicable part for ATG by considering the same corresponding scenario. FR2 and FR1 non-collocated part should be deleted. |
| **8.2.2.2.3** | Interruptions during measurements on deactivated SCC | The requirement can be reused by focusing on the applicable part for ATG by considering the same corresponding scenario. FR2 and FR1 non-collocated part should be deleted. |
| **8.2.2.2.4** | Interruptions at UL carrier RRC reconfiguration | The requirement can be reused by focusing on the applicable part for ATG by considering the same corresponding scenario. SUL part should be deleted. |
| **8.2.2.2.5** | Interruptions due to Active BWP switching Requirement | The requirement can be reused by focusing on the applicable part for ATG by considering the same corresponding scenario. |
| **8.2.2.2.6** | Interruptions at inter-frequency SFTD measurement | The requirement can be reused by focusing on the applicable part for ATG by considering the same corresponding scenario. |
| **8.2.2.2.7** | Interruptions at SCell activation/deactivation with multiple downlink SCells | Not applicable to ATG UE due to single Scell in Rel-19. |
| **8.2.2.2.8** | Interruptions due to UE-specific CBW change | Can be completely reused for ATG UE. |
| **8.2.2.2.9** | Interruptions at NR SRS carrier based switching | Can be reused for ATG UE. |
| **8.2.2.2.10** | DL Interruptions at UE switching between two uplink carriers | RAN4 need to discuss whether ATG UE would aim to support the feature of UE switching between 2 uplink carriers. We think current inter-band CA\_n3-n39 combination seem has no such demand. |
| **8.2.2.2.10A** | DL Interruptions at UE switching between two uplink carriers with two transmit antenna connectors | Same comment as for 8.2.2.10. |
| **8.2.2.2.10B** | DL Interruptions at UE switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors | Same comment as for 8.2.2.10. |
| **8.2.2.2.10C** | DL Interruptions at UE switching between two uplink bands with two transmit antenna connectors | Same comment as for 8.2.2.10. |
| **8.2.2.2.10D** | DL Interruptions at UE switching across three or four uplink bands | Same comment as for 8.2.2.10. |
| **8.2.2.2.11** | Interruptions at direct SCell activation | Can be reused. |
| **8.2.2.2.12** | Interruptions due to SCell dormancy | Can be reused. |
| **8.2.2.2.13** | Interruptions at transitions between active and non-active during DRX | Not applicable |
| **8.2.2.2.14** | Interruptions when identifying CGI of an NR cell with autonomous gaps | Seems not useful for ATG UE. |
| **8.2.2.2.15** | Interruptions when identifying CGI of an E-UTRA cell with autonomous gaps | Not applicable |
| **8.2.2.2.16** | Interruptions at NR SRS antenna port switching | Can be reused. |
| **8.2.2.2.17** | Interruptions at fast SCell activation | Can be reused. |
| **8.2.2.2.18** | Interruptions due to PUCCH SCell activation/deactivation | Can be reused. |
| **8.2.2.2.19** | Interruptions due to measurements without gap carried out by UE supporting [NeedForInterruptionInfoNR-R18] | Can be reused for ATG. |
| **8.2.2.2.20** | Interruptions due to PDCCH ordered RACH on target LTM cell | ATG cell switching is not so frequent. And LTM feature is still in the process of optimizing and being enhanced. We think it’s not necessary to complicate the ATG mobility at this stage. If there is real demand for this feature, can be reconsidered in future release when LTM feature is stable for TN. |

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| R4-2411644 | Ericsson | Observation 1: ATG handover requirements are not impacted by the introduction of CA.Observation 2: The introduction of ATG CA does not impact UE Timing advanced, UE transmit timing, and UE timer accuracy requirements.Proposal 1 : RAN4 to discuss and agree the scope of the WI is limited to the following two scenarios stated in the WID Intra-band co-located contiguous DL CA. Inter-band co-located DL CAProposal 2 : RAN4 to reuse NR cell re-selection as a baseline for ATG cell re-selection to support CA.Proposal 3 : RAN4 to define EMR for ATG DL CA by using the Rel-18 NR CA EMR as a baseline.Proposal 4 : RAN4 should discuss and define co-location in the context of ATG in Rel-19.Proposal 5 : RAN4 should discuss and define MRTD requirements for co-located ATG CA deployments, using the corresponding NR CA requirements as a baseline.Proposal 6: RAN4 to define Scell activation/deactivation requirements for ATG CA by using the corresponding NR CA requirements as a baseline.Proposal 7: SCell activation requirements shall be further investigated for potential impact, taking into account the band combinations stated in the WID and the antenna types agreed in RF.Proposal 8 : RAN4 to reuse NR carrier aggregation measurement gap as the baseline for ATG DL CA.Proposal 9: RAN4 to study and accommodate CSSF requirements for ATG DL CA.Proposal 10: RAN4 to further study the impact of antenna pattern on scheduling availability ATG CA. |
| R4-2411687 | LG Electronics | Proposal 1: For MRTD requirements in ATG CA operation, existing MRTD for intra-band CA as 3us can be reusded for both ATG intra- and inter-band CA.Proposal 2: FFS whether co-location information in inter-band CA configuration should be provided to UE.Proposal 3: Reuse the principle from existing SCell activation / deactivation delay requirements as baseline for ATG, and scellWithoutSSB capability can be considered.Proposal 4: Reuse the principle from exsiting interruption requirements for SCell activation/deactivation and during measurement on deactivated SCell as baseline for ATG.Proposal 5: Reuse the principle from the existing cell identification and measurement requirements with measCycleScell as baseline for ATGProposal 6: RAN4 needs to further discuss whether different antenna type for inter-band CA operatrion is considered. |
| R4-2411758 | CMCC | Proposal 1: Focus on FR1 DL co-located CA scenario, including intra-band contiguous CA and inter-band CA.Proposal 2: For other ATG scenario characteristics like UE speed, ISD and so on, the R18 working assumption will be reused.Proposal 3: For intra-band contiguous CA, same antenna type should be applied on each carrier, including one or more omni-directional antenna(s) and antenna array.Proposal 4: For inter-band CA, either different or same antenna type can be applied on different carriers.Proposal 5: If only antenna array is used, then may exists two cases:Case 1: UE only have one antenna panel and form one Rx beamCase 2: UE have two antenna panels and can form two simultaneous Rx beamsProposal 6: For cell re-selection, define the exceptions of side conditions for UE supporting CA in FR1. The legacy methodology exception applicability defined in Clause 4.2 and Clause B.3.2.1 can be reused with update of the reference clause of ΔRIB,c.Observation 1: Fail to see strong demand and significant gain to introduce EMR in ATG co-located deployment.Proposal 7: No need to introduce EMR in ATG CA if no strong demand and significant gain observed.Proposal 8: No need to introduce MRTD requirement for ATG intra-band contiguous CA.Proposal 9: Define MRTD requirement for ATG inter-band CA, legacy 33µs requirement can be reused.Proposal 10: For SCell activation and deactivation, following features can be introduced for ATG, reuse the current FR1 requirements as the starting point, and further study whether further improvement is needed or not due to co-located deployment.SCell Activation Delay Requirement for Deactivated SCellSCell Deactivation Delay Requirement for Activated SCellDirect SCell Activation at SCell additionDirect SCell Activation at HandoverDirect SCell Activation at RRCResumeFast SCell Activation Delay Requirement for Deactivated SCellSCell Activation Delay Requirement for Deactivated SCell with the L3 reporting during activation.Proposal 11: For Active BWP switch delay on multiple CCs, introduce following requirements, which can reuse the legacy:Simultaneous DCI based BWP switch delay on multiple CCsSimultaneous RRC based BWP switch delay on multiple CCsSimultaneous and non-simultaneous Timer based BWP switch delay on multiple CCsProposal 12: Introduce Beam failure recovery in SCell for ATG CA, the legacy procedure and requirement can be reused.Proposal 13: Introduce Pre-configured measurement gap activation/deactivation delay requirement upon SCell activation/deactivation, the legacy requirement can be reused.Proposal 14: Introduce the following interruption requirement, the legacy requirement can be reused.Interruptions at SCell addition/releaseInterruptions at SCell activation/deactivationInterruptions at direct SCell activationInterruptions at fast SCell activationInterruptions during measurements on deactivated SCCInterruptions due to SCell dormancyInterruptions due to Active BWP switching RequirementInterruptions due to UE-specific CBW changeInterruptions when identifying CGI of an NR cell with autonomous gapsInterruptions at NR SRS antenna port switchingProposal 15: Reuse the legacy scheme when defining the CSSFoutside\_gap for ATG FR1 only CA, that PCC occupy one measurement searcher resource, SCC and other inter-frequency MO with no measurement gap share another measurement searcher resource.Proposal 16: The measurement gap applicability rule and scheduling applicability for SA single carrier shall be also applied for NR CA configuration.Proposal 17: When define the SCC interruption time, only consider aligned frame boundaries scenario, the interruption requirement in single carrier case can be reused for CA configuration.Proposal 18: For UE capability of supporting NR reporting criteria of category intra-frequency, the SCell serving frequency shall be counted in the number of configured NR serving frequencies carrier frequency.Proposal 19: Introduce the SCell related triggering conditions as an event for triggering pre-configured measurement gap, and the legacy procedure and requirement can be reused.Proposal 20: If SCell Activation for Deactivated SCell with the L3 reporting during activation is supported for ATG, then the measurement reporting requirement shall also be introduced, legacy requirement can be reused.Proposal 21: Introduce Time period for PSS/SSS detection, Time period for time index detection, Measurement period for intra-frequency measurements without gaps for FR1 deactivated SCell. The legacy requirement can be reused, for ATG UE with one or more omni-directional antenna and ATG UE with antenna array on SCC.Proposal 22: For scheduling availability of UE performing measurement with a different subcarrier spacing than PDSCH/PDCCH for RLM, BFD, CBD, intra/inter-frequency measurement without MG, L1-RSRP measurement, and L1-SINR measurementWhen intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on FR1 serving PCell should apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands than the bands in which PCell is configured.Proposal 23: For scheduling availability of UE performing measurements on FR1 TDD band for intra/inter-frequency measurement without MG and CSI-RS based intra-frequency measurementsWhen TDD intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols. When TDD inter-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to another serving cell in a different band on the symbols that fully or partially overlap with the aforementioned restricted symbols, if UE does not have the capability of supporting simultaneousRxTxInterBandCA for this band pair. Proposal 24: For scheduling availability of UE with the antenna array performing measurements on FR1 for intra/inter-frequency measurement without MG and CSI-RS based intra-frequency measurements:When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions due to a given serving cell also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.When inter-band carrier aggregation is performed:For ATG UE with the antenna array on PCC and one or more omni-directional antenna on SCC, the scheduling restrictions due to PCell will not apply to another serving cell in a different band.For ATG UE with the one or more omni-directional antenna on PCC and antenna array on SCC, the scheduling restrictions due to SCell will not apply to another serving cell in a different band.For ATG UE with the antenna array on both PCC and SCC, and only one Rx beam can be formed, the scheduling restrictions due to a given serving cell should also apply to another serving cell in a different band on the symbols that fully or partially overlap with the aforementioned restricted symbols.For ATG UE with the antenna array on both PCC and SCC, and two Rx beams can be formed simultaneously, he scheduling restrictions due to a given serving cell will not apply to another serving cell in a different band. |
| R4-2412229 | Huawei, HiSilicon | Observation 1: There could be different antenna types for inter-band CA as agreed in RF session.Proposal 1: RAN4 to discuss the antenna types for inter-band CA and corresponding impacts on RRM requirements.Proposal 2: RAN4 to define MRTD requirements for inter-band and intra-band CA scenarios for Rel-19 ATG.Proposal 3: RAN4 to discuss whether to reuse the same MRTD requirements.Proposal 4: RAN4 to define SCell activation for single-SCell for at least:SCell activation Direct SCell activation at SCell additionDirect SCell activation at HandoverProposal 5: Existing interruption requirements can also apply to ATG supporting CA. RAN4 could discuss whether to introduce new interruption requirements if there are ATG new procedures which are not covered in current interruption requirements.Proposal 6: RAN4 to define intra-frequency measurement requirements for deactivated SCell.  |
| R4-2413078 | ZTE Corporation, Sanechips | Observation 1: The extension of co-located CA has no impact on the beam sweeping factor N defined in R18 ATGProposal 1: The discussion on CSSF calculation, supported cell number and SSB number, can be held separately for the assumption of omni-directional antenna and antenna array. The former is legacy FR1 like, and the latter is legacy FR2 like.Proposal 2: Under the assumption of omni-directional antenna, directly reuse the legacy FR1 CSSFoutside\_gap calculation, supported cell number and SSB number. Observation 2: Two searchers are assumed. The principle of allocation of two searchers in legacy FR1 and FR2 is somehow different. Proposal 3: Under the assumption of omni-directional antenna, reuse the assumption of two searcher allocation strategy between all serving CCs and neighbour cells in legacy FR1. That is, PCC specifically uses the 1st searcher, all SCCs and intra-f/inter-f neighbour cells equally share the 2nd searcher.Observation 3: In legacy FR2, only a single intra-frequency neighbour cell is allowed to measure per band.Proposal 4: Under the assumption of antenna array, no need to leverage the legacy restriction on intra-f neighbour cell number per band in FR2. In other words, no additional restriction on the neighbour cell number allowed.Proposal 5: Under the assumption of antenna array, reuse the assumption of two searcher allocation strategy between all serving CCs and neighbour cells in legacy FR1. That is, PCC specifically uses the 1st searcher, all SCCs and intra-f/inter-f neighbour cells equally share the 2nd searcher.(i.e. same as that for omni-directional antenna)Observation 4: For the activated SCell measurement, no additional factor to consider, reuse same requirements as R18 ATG intra-f measurements.Observation 5: For the deactivated SCell measurement, whether need to introduce smaller candidate of measCycleSCell to facilitate the small ISD ATG deployment, which can be considered.Proposal 6: the scheduling restriction extension to intra-band/inter-band CA should be identified. Which can be discussed for omni-directional antenna and antenna array separately.Observation 6: In legacy(including R16/17/18), EMR only enables for the IDLE/INACTIVE state triggered by RRCRelease signalling. The IDLE/INACTIVE state caused by other reasons, including initial access and RLM/handover failure can not enable EMR. Proposal 7: Considering the CPE would be always online during one trip of flight, the applicable condition of EMR would not happen, so no need to consider EMR in R19 ATG.Observation 7: No impact on R18 ATG handover/CHO. Not need additional enhancement.Observation 8: For both omni-directional antenna and antenna array assumption, reuse existing interruption requirements of SCell addition/release.Observation 9: The component of cell search can be ignored.Observation 10: Due to co-located deployment, similar beam coverage shared between multiple serving cells, whether L1 meas&report can be ignored, which can be discussed.Observation 11: No impact on unified TCI state indication. |

## Open issues summary

### Sub-topic 1-1 General

*Discuss some general issue, such as scenario, UE type, and so on.*

*Open issues and candidate options before meeting:*

**Issue 1-1-1: Scenario**

* Proposals
	+ Proposal 1: Only consider FR1 co-located DL intra-band contiguous CA and inter-band CA (CATT, Ericsson, CMCC)
	+ Proposal 2: For other ATG scenario characteristics like UE speed, ISD and so on, the R18 working assumption will be reused (CMCC)
* Recommended WF
	+ P1 and P2 can be agreed

**Issue 1-1-2: Co-located definition**

* Background
	+ According to RP-180557, LS response on work to support IMT-2020/5G in the Transport Network, the definition of co-located for MIMO, Tx diversity transmissions, and intra-band contiguous carrier aggregation is as follows:

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| RAN thanks ITU-T Study Group 15 for their LS/r on the initiation of work to support IMT-2020/5G in the Transport Network. In that document, ITU-T SG15 asked if it is correct to expect that in the case of MIMO or Tx diversity transmissions, and intra-band contiguous carrier aggregation, that the antennas typically be co-located (same site).In 3GPP RAN, the above-mentioned features are specified to be applied intra-gNB, where the gNB is a logical node. A gNB is then typically implemented within a “base station” that is deployed at a “site”. Although base station antennas of the same “site” can be deployed at different locations within that site, e.g. different corners of a roof, it is correct to assume that the distribution of the reference timing signal would not be required between sites; an intra-site timing distribution would suffice. |

* Proposals
	+ Proposal 1: RAN4 should discuss and define co-location in the context of ATG in Rel-19 (Ericsson)
* Recommended WF
	+ Discuss and define co-location for R19 ATG
		- Option 1: Reuse the legacy definition for MIMO, Tx diversity transmissions, and intra-band contiguous carrier aggregation, as defined in RP-180557.
		- Option 2: Antennas at the same physical location, or the distance difference between antennas can be ignored.
		- Other Options are not precluded

**Issue 1-1-3: Co-location signaling**

* Proposals
	+ Proposal 1: FFS whether co-location information in inter-band CA configuration should be provided to UE. (LGE)
* Recommended WF
	+ To be Discussed

**Issue 1-1-4: Whether to support multiple downlink SCells**

* Proposals
	+ Proposal 1: Only consider single SCell for R19 ATG CA (Apple)
	+ Proposal 2: Deprioritize multiple downlink SCells (CMCC)
* Recommended WF
	+ Only consider single SCell for R19 ATG CA

**Issue 1-1-5: UE antenna type**

* Background

RAN4#111 meeting has achieved following agreement about antenna type:

**Issue 3-1: clarify the antenna type for each band for inter-band CA**

Agreement:

No limitation on antenna types for ATG CA

FFS on whether to assume omni-antenna type can be assumed for both band n3 and n39 in DL CA\_n3-n39

FFS on whether new capability is needed for ATG CA

* Proposals
	+ Proposal 1: For intra-band contiguous CA, same antenna type should be applied on each carrier, including one or more omni-directional antenna(s) and antenna array. (CMCC)
	+ Proposal 2: For inter-band CA, either different or same antenna type can be applied on different carriers. (Ericsson, CMCC, HW)
		- Proposal 2-1: Specifically, for inter-band CA, there are five cases: (Ericsson, CMCC)
			* 1. ATG UE with omnidirectional antennas on both PCell and SCell/s.
			* 2. ATG UE with an omnidirectional antenna on PCell and an antenna array on SCell/s.
			* 3. ATG UE with an antenna array on PCC and an omnidirectional antenna on SCell/s.
			* 4. ATG UE with an antenna array on both PCell and SCell/s with only one antenna panel.
			* 5. ATG UE with an antenna array on both PCell and SCell/s with separate antenna panels.
	+ Proposal 3: RAN4 needs to further discuss whether different antenna type for inter-band CA operation is considered. (LGE)
* Recommended WF
	+ Proposal 1 can be agreed
	+ Proposal 2 can be agreed which aligns with RF agreement
	+ Further check Proposal 2-1

**Issue 1-1-6: Specification structure**

* Proposals
	+ Proposal 1: The CA related requirements can be directly added in the sections defined for R18 ATG UE (CATT)
* Recommended WF
	+ To be discussed, maybe in case by case manner.

### Sub-topic 1-2 RRC\_IDLE/ RRC\_INACTIVE state mobility

*Open issues and candidate options before meeting:*

**Issue 1-2-1: Cell re-selection Idle/Inactive mode CA measurements**

* Proposals
	+ Proposal 1: RAN4 to reuse NR cell re-selection as a baseline for ATG cell re-selection to support CA. (Ericsson)
	+ Proposal 2: For cell re-selection, define the exceptions of side conditions for UE supporting CA in FR1. The legacy methodology exception applicability defined in Clause 4.2 and Clause B.3.2.1 can be reused with update of the reference clause of ΔRIB,c. (CMCC)
* Recommended WF
	+ Reuse NR cell re-selection as a baseline, further add side condition exceptions for UE supporting CA.
		- The legacy methodology exception applicability defined in Clause 4.2 and Clause B.3.2.1 can be reused with update of the reference clause of ΔRIB,c.

**Issue 1-2-2: Idle/Inactive mode CA measurements (R16)**

* Proposals
	+ Option 1: Introduce idle/inactive mode CA measurements requirements for ATG UE in Rel-19 (CATT, Ericsson)
	+ Option 2: No need to introduce idle/inactive mode CA measurements requirements in ATG CA. (Apple, CMCC, ZTE)
* Recommended WF
	+ To be discussed

**Issue 1-2-3: Measurement report for fast CA/DC setup (R18)**

* Proposals
	+ Option 1: RAN4 to define EMR for ATG DL CA by using the Rel-18 NR CA EMR as a baseline (Ericsson)
	+ Option 2: No need to introduce Rel-18 NR CA EMR in ATG CA. (CMCC, ZTE)
	+ Option 3: Consider whether to define the requirements of measurement report for fast CA setup in idle/inactive mode for R19 ATG UE (CATT)
* Recommended WF
	+ To be discussed

### Sub-topic 1-3 Timing

*Open issues and candidate options before meeting:*

**Issue 1-3-1: MTTD**

* Proposals
	+ Option 1: Introduce MTTD requirements for ATG Carrier Aggregation (CATT)
	+ Option 2: FFS whether MTTD requirement is needed or not (Apple)
* Recommended WF
	+ To be discussed

**Issue 1-3-2: MRTD**

* Proposals
	+ Option 1: Introduce MRTD requirements for ATG Carrier Aggregation (CATT, Ericsson, LGE, HW)
		- Option 1-1: For inter-band co-located CA, MRTD = TAE + ΔRF\_prop + Dispersion = 3 µs+ 0.3 µs+0.245 µs= 3.545 µs (Ericsson)
		- Option 1-2: For MRTD requirements in ATG CA operation, existing MRTD for intra-band CA as 3us can be reused for both ATG intra- and inter-band CA. (LGE)
		- Option 1-3: No need to introduce MRTD requirement for ATG intra-band contiguous CA. Define MRTD requirement for ATG inter-band CA, legacy 33µs requirement can be reused. (CMCC)
	+ Option 2: FFS whether MRTD requirement is needed or not (Apple)
* Recommended WF
	+ To be discussed
		- For ATG intra-band contiguous CA, MRTD is needed or not?
		- For ATG inter-band CA, MRTD is?

### Sub-topic 1-4 Signalling characteristics

*Open issues and candidate options before meeting:*

**Issue 1-4-1: Interruption requirements**

* Proposals
	+ Proposal 1: Interruption requirements should be introduced for ATG UE (CATT, Apple, HW, LGE, ZTE)
		- Proposal 1-1: Interruption requirements should be defined for following features, legacy requirement can be reused by focusing on the applicable part for ATG by considering the same corresponding scenario (Apple)
			* Requirement applicability, some adaptation is needed depending on the supported feature by ATG UE
			* Interruption at Scell addition/release
			* Interruptions at SCell activation/deactivation
			* Interruptions during measurements on deactivated SCC
			* Interruptions at UL carrier RRC reconfiguration
			* Interruptions due to Active BWP switching Requirement
			* Interruptions at inter-frequency SFTD measurement
			* Interruptions due to UE-specific CBW change
			* Interruptions at NR SRS carrier based switching
			* Interruptions at direct SCell activation
			* Interruptions due to SCell dormancy
			* Interruptions at NR SRS antenna port switching
			* Interruptions at fast SCell activation
			* Interruptions due to PUCCH SCell activation/deactivation
			* Interruptions due to measurements without gap carried out by UE supporting [NeedForInterruptionInfoNR-R18]
			* FFS:
				+ DL Interruptions at UE switching between two uplink carriers
				+ DL Interruptions at UE switching between two uplink carriers with two transmit antenna connectors
				+ DL Interruptions at UE switching between two uplink bands with two transmit antenna connectors
				+ DL Interruptions at UE switching across three or four uplink bands
				+ Interruptions when identifying CGI of an NR cell with autonomous gaps
		- Proposal 1-2: Reuse the principle from existing interruption requirements as baseline for ATG for: (LGE)
			* Interruptions at SCell activation/deactivation
			* Interruptions during measurement on deactivated SCell
		- Proposal 1-3: Introduce the following interruption requirement, the legacy requirement can be reused. (CMCC)
			* Interruptions at SCell addition/release
			* Interruptions at SCell activation/deactivation
			* Interruptions at direct SCell activation
			* Interruptions at fast SCell activation
			* Interruptions during measurements on deactivated SCC
			* Interruptions due to SCell dormancy
			* Interruptions due to Active BWP switching Requirement
			* Interruptions due to UE-specific CBW change
			* Interruptions when identifying CGI of an NR cell with autonomous gaps
			* Interruptions at NR SRS antenna port switching
		- Proposal 1-4: Existing interruption requirements can also apply to ATG supporting CA. RAN4 could discuss whether to introduce new interruption requirements if there are ATG new procedures which are not covered in current interruption requirements. (HW)
		- Proposal 1-5: For both omni-directional antenna and antenna array assumption, reuse existing interruption requirements of SCell addition/release. (ZTE)
* Recommended WF
	+ Interruption requirements should be introduced for ATG UE, and further discuss:
		- Which interruption requirement should be introduced?
		- Whether legacy requirement can be reused?

**Issue 1-4-2: SCell Activation and Deactivation Delay**

* Proposals
	+ Proposal 1: SCell Activation and Deactivation Delay requirements should be introduced for ATG (CATT, Ericsson, LGE, CMCC)
		- Proposal 1-1: SCell activation requirements shall be further investigated for potential impact, taking into account the band combinations stated in the WID and the antenna types agreed in RF (Ericsson)
		- Proposal 1-2: Reuse the principle from existing SCell activation / deactivation delay requirements as baseline for ATG, and scellWithoutSSB capability can be considered. (LGE)
		- Proposal 1-3: Introduce following features for ATG, reuse the current FR1 requirements as the starting point, and further study whether further improvement is needed or not due to co-located deployment: (CMCC)
			* + SCell Activation Delay Requirement for Deactivated SCell
				+ SCell Deactivation Delay Requirement for Activated SCell
				+ Direct SCell Activation at SCell addition
				+ Direct SCell Activation at Handover
				+ Direct SCell Activation at RRCResume
				+ Fast SCell Activation Delay Requirement for Deactivated SCell
				+ SCell Activation Delay Requirement for Deactivated SCell with the L3 reporting during activation.
		- Proposal 1-4: RAN4 to define SCell activation for single-SCell for at least: (HW)
			* + SCell activation
				+ Direct SCell activation at SCell addition
				+ Direct SCell activation at Handover
		- Proposal 1-5: Due to co-located deployment, similar beam coverage shared between multiple serving cells, the component of cell search can be ignored, whether L1 meas&report can be ignored, which can be discussed. (ZTE)
* Recommended WF
	+ SCell Activation and Deactivation Delay requirements should be introduced for ATG, reuse the current FR1 requirements as the starting point
		- Further discuss which feature related requirements should be defined by RAN4
		- Further discuss whether enhancement/update is needed considering band combinations, antenna types, and co-located deployment.

**Issue 1-4-3: Active BWP switch delay on multiple CCs**

* Proposals
	+ Proposal 1: For Active BWP switch delay on multiple CCs, introduce following requirements, which can reuse the legacy: (CMCC)
		- Simultaneous DCI based BWP switch delay on multiple CCs
		- Simultaneous RRC based BWP switch delay on multiple CCs
		- Simultaneous and non-simultaneous Timer based BWP switch delay on multiple CCs
* Recommended WF
	+ To be discussed

**Issue 1-4-4: Beam failure recovery in SCell**

* Proposals
	+ Proposal 1: Introduce Beam failure recovery in SCell for ATG CA, the legacy procedure and requirement can be reused. (CMCC)
* Recommended WF
	+ To be discussed

**Issue 1-4-5: Pre-configured measurement gap activation/deactivation delay upon SCell activation/deactivation**

* Proposals
	+ Proposal 1: Introduce Pre-configured measurement gap activation/deactivation delay requirement upon SCell activation/deactivation, the legacy requirement can be reused. (CMCC)
* Recommended WF
	+ To be discussed

### Sub-topic 1-5 Measurement procedure

*Open issues and candidate options before meeting:*

**Issue 1-5-1: Measurement gap**

* Proposals
	+ Proposal 1: RAN4 to reuse NR carrier aggregation measurement gap as the baseline for ATG DL CA (Ericsson)
	+ Proposal 2: The measurement gap applicability rule and scheduling applicability for SA single carrier shall be also applied for NR CA configuration. (CMCC)
	+ Proposal 3: When define the SCC interruption time, only consider aligned frame boundaries scenario, the interruption requirement in single carrier case can be reused for CA configuration. (CMCC)
* Recommended WF
	+ Further discuss P1 and P2
	+ Check whether P3 can be agreed

**Issue 1-5-2: CSSF**

* Proposals
	+ Proposal 1: Study and accommodate CSSF requirements for ATG DL CA (Ericsson)
	+ Proposal 2: Reuse the legacy scheme when defining the CSSFoutside\_gap for ATG FR1 only CA, that PCC occupy one measurement searcher resource, SCC and other inter-frequency MO with no measurement gap share another measurement searcher resource. (CMCC, ZTE)
* Recommended WF
	+ Check whether P2 can be agreed

**Issue 1-5-3: Capabilities for Support of Event Triggering and Reporting Criteria**

* Proposals
	+ Proposal 1: For UE capability of supporting NR reporting criteria of category intra-frequency, the SCell serving frequency shall be counted in the number of configured NR serving frequencies carrier frequency. (CMCC)
* Recommended WF
	+ Check whether P1 can be agreed

**Issue 1-5-4: Pre-configured measurement gap requirement**

* Proposals
	+ Proposal 1: Introduce the SCell related triggering conditions as an event for triggering pre-configured measurement gap, and the legacy procedure and requirement can be reused. (CMCC)
* Recommended WF
	+ To be discussed

**Issue 1-5-5: SCell activation triggered measurement reporting requirement**

* Proposals
	+ Proposal 1: If SCell Activation for Deactivated SCell with the L3 reporting during activation is supported for ATG, then the measurement reporting requirement shall also be introduced, legacy requirement can be reused. (CMCC)
* Recommended WF
	+ Depends on whether the feature ‘SCell Activation for Deactivated SCell with the L3 reporting during activation’ will be supported or not, can be discussed after Issue 1-4-2 agreed

**Issue 1-5-6: Beam sweeping factor N**

* Proposals
	+ Proposal 1: The extension of co-located CA has no impact on the beam sweeping factor N defined in R18 ATG. (ZTE)
* Recommended WF
	+ Check whether P1 can be agreed

**Issue 1-5-7: Deactivated SCell measurement**

* Proposals
	+ Proposal 1: Define intra-frequency measurement requirements for deactivated SCell (LGE, CMCC, HW)
		- Option 1-1: Reuse the principle from the existing cell identification and measurement requirements with measCycleScell as baseline for ATG, for example (LGE)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra  |
| No DRX | ceil( 5 x Kp x N1 Note 1 x Klayer1\_measurement) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | ceil(5 x Kp x N1 Note 1 x Klayer1\_measurement) x max(measCycleSCell, 1.5 x DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil( 5 x Kp x N1 Note 2 x Klayer1\_measurement) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: For ATG UE with the antenna array, N1 = 3 when network assistance on ATG cells reference locations is provided, otherwise N1 = 4.Otherwise, N1 = 1. |

* + - Option 1-2: Introduce Time period for PSS/SSS detection, Time period for time index detection, Measurement period for intra-frequency measurements without gaps for FR1 deactivated SCell. The legacy requirement can be reused, for ATG UE with one or more omni-directional antenna and ATG UE with antenna array on SCC. (CMCC)
		- Option 1-3: For the deactivated SCell measurement, whether need to introduce smaller candidate of measCycleSCell to facilitate the small ISD ATG deployment, which can be considered. (ZTE)
* Recommended WF
	+ Define intra-frequency measurement requirements for deactivated SCell by reusing the principle from the existing cell identification and measurement requirements with measCycleScell as baseline
		- Further discuss whether beam sweeping factor N1 and L3/L1 measurement sharing factor Klayer1\_measurement is needed or not
		- Further discuss whether smaller candidate of measCycleSCell is needed or not

**Issue 1-5-8: Scheduling Availability/Restrictions**

* Proposals
	+ Proposal 1: the scheduling restriction extension to intra-band/inter-band CA, further study the impact of antenna pattern on scheduling availability ATG CA (Ericsson, ZTE)
	+ Proposal 2: For scheduling availability of UE performing measurement with a different subcarrier spacing than PDSCH/PDCCH for RLM, BFD, CBD, intra/inter-frequency measurement without MG, L1-RSRP measurement, and L1-SINR measurement (CMCC)
		- When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on FR1 serving PCell should apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.
		- When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands than the bands in which PCell is configured.
	+ Proposal 3: For scheduling availability of UE performing measurements on FR1 TDD band for intra/inter-frequency measurement without MG and CSI-RS based intra-frequency measurements (CMCC)
		- When TDD intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.
		- When TDD inter-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to another serving cell in a different band on the symbols that fully or partially overlap with the aforementioned restricted symbols, if UE does not have the capability of supporting simultaneousRxTxInterBandCA for this band pair.
	+ Proposal 4: For scheduling availability of UE with the antenna array performing measurements on FR1 for intra/inter-frequency measurement without MG and CSI-RS based intra-frequency measurements:
		- When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions due to a given serving cell also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.
		- When inter-band carrier aggregation is performed:
			* For ATG UE with the antenna array on PCC and one or more omni-directional antenna on SCC, the scheduling restrictions due to PCell will not apply to another serving cell in a different band.
			* For ATG UE with the one or more omni-directional antenna on PCC and antenna array on SCC, the scheduling restrictions due to SCell will not apply to another serving cell in a different band.
			* For ATG UE with the antenna array on both PCC and SCC, and only one Rx beam can be formed, the scheduling restrictions due to a given serving cell should also apply to another serving cell in a different band on the symbols that fully or partially overlap with the aforementioned restricted symbols.
			* For ATG UE with the antenna array on both PCC and SCC, and two Rx beams can be formed simultaneously, he scheduling restrictions due to a given serving cell will not apply to another serving cell in a different band.
* Recommended WF
	+ The scheduling restriction extension to intra-band/inter-band CA, further study the impact of antenna pattern on scheduling availability ATG CA