3GPP TSG RAN WG1 #104-e R1-21xxxxx

e-Meeting, January 25th – February 5th, 2021

**Agenda item: 5**

**Source: Moderator (Nokia)**

**Title:** **Moderator summary of [104-e-AI5-LS-02]
Email discussion/approval for the reply LS to R1-200023**

**Document for: Discussion and Decision**

# 1 Introduction

RAN1 received an LS from RAN2 on TEI16-introduced half-duplex operation
[R1-2100023](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Docs/R1-2100023.zip) *LS on half-duplex operation*, RAN2 (Nokia), with the following

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| **1. Overall Description:**RAN2 noticed that while the capability *half-DuplexTDD-CA-SameSCS-r16* (corresponding to RAN1 feature group 14-5) was introduced in RAN2#111-e, the corresponding configuration parameter (which was included in the RAN1 feature list in R1-2003190) has mistakenly not been introduced in the September 2020 version of the RRC specification (V16.2.0).RAN2 would like to inform RAN1 that the configuration parameter *directionalCollisionHandling-r16* has now been introduced as part of *ServingCellConfig*, i.e. as a per-serving cell parameter. RAN2 also thought that the parameter should only apply within the same frequency range and cell group: That is, only the cells configured with *directionalCollisionHandling-r16* within the same cell group and frequency range are considered for determining the corresponding R16 half-duplex behavior for each case. RAN2 would like to ask whether there should be additional network restrictions: currently the RAN2 field description assumes this would only apply to TDD CA for cells with the same SCS, but it was not clear if it would always apply to all TDD CA cells with the same SCS or whether it's up to network it is configured only for some cells? **2. Actions:****To RAN WG1 group.****ACTION:** RAN2 respectfully asks RAN1 to take the configuration parameter details into account in their specifications. RAN2 would also like to ask if the half-duplex operation should always apply to all TDD cells in the same cell group, or whether network can choose for which cells it applies within a cell group? |

6 contributions related to the LS were submitted to AI5:

* [R1-2100085](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Docs/R1-2100085.zip) [DRAFT] Reply LS on half-duplex operation ZTE
* [R1-2100319](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Docs/R1-2100319.zip) Draft reply LS on half-duplex operation CATT
* [R1-2100504](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Docs/R1-2100504.zip) On half-duplex operation Nokia, Nokia Shanghai Bell
* [R1-2101158](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Docs/R1-2101158.zip) Discussion on Configuration for CA Half duplex operation vivo
* [R1-2101163](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Docs/R1-2101163.zip) Draft reply LS on half-duplex operation Samsung
* [R1-2101745](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Docs/R1-2101745.zip) Discussion on LS on half-duplex operation Huawei, HiSilicon

# 2 Proposals submitted to AI5 related to the LS

## 2.1 R1-2100085

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| **1. Overall Description:**RAN1 would like to thank RAN2 for the LS R1-210023 (R2-2010809) on half-duplex operation. RAN1 confirms that only the cells configured with *directionalCollisionHandling-r16* within the same cell group and frequency range are considered for determining the corresponding R16 half-duplex behavior for each case. From RAN1 perspective, network can choose for which cell(s) the half-duplex operation applies within a cell group.**2. Actions:****To RAN2 group.****ACTION:** RAN1 respectfully asks RAN2 to take the above information into account. |

## 2.2 R1-2100319

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| **1. Overall Description:**RAN1 thanks RAN2 for the LS on Rel-16 half-duplex operation in R1-2100023 (R2-2010809), in which RAN1 is asked if the half-duplex operation should always apply to all TDD cells in the same cell group, or whether network can choose for which cells it applies within a cell group.RAN1 would like to provide our understanding as follows for different cases:* For TDD intra-band CA, half-duplex operation should be applied to all TDD cells in the same frequency band.
* For TDD inter-band CA,
	+ If a UE supports simultaneous transmission and reception in TDD-TDD inter-band CA (*simultaneousRxTxInterBandCA*), half-duplex operation should be applied to all TDD cells in each frequency band.
	+ If a UE does not support simultaneous transmission and reception in TDD-TDD inter-band CA (*simultaneousRxTxInterBandCA*), half-duplex operation should be applied to all TDD cells in the same and different frequency bands.

**2. Actions:****To RAN2 group.****ACTION:** RAN1 respectfully asks RAN2 to take the above information into account in their work. |

## 2.3 R1-2100504

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| **1. Overall Description:**RAN1 would like to than RAN2 on the LS on half-duplex operation in R1-2100023/R2-2010809. RAN1 discussed the LS and has agreed to a CR to 38.213 with the following modifications to the conditions when the half-duplex operation applies:

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| If a UE - is configured with multiple serving cells and is provided with ~~half-duplex-behavior~~ directionalCollisionHandling-r16 = '~~enable~~enabled' for at least one serving cell, and- the subcarrier spacing of the active bandwidth part in all the multiple serving cells is the same, and- is not capable of simultaneous transmission and reception on any of the multiple serving cells as indicated with *simultaneousRxTxInterBandCA* capability, and- indicates support of capability for half-duplex operation in CA with unpaired spectrum with *half-DuplexTDD-CA-SameSCS-r16* capability, and - is not configured to monitor PDCCH for detection of DCI format 2\_0 on any of the multiple serving cells,… |

The changes are summarized as follows:* In response to the RAN2 question on whether the configuration should apply to all cells, RAN1 has clarified in the 1st bullet that if the configuration is provided to any serving cell, then it is applied to all serving cells
* In response to RAN2 pointing out the RRC parameter name used to configure the operation, the parameter name has been corrected in the 1st bullet
* In response to RAN2 asking if additional network restrictions should be defined, RAN1 has introduced a new 2nd bullet restricting all the configured cells to be using the same SCS
* In addition to the above, the (now) 3rd and 4th bullet specify the UE capability that is being referred to in these bullets

With the above changed agreed to TS38.213, the RAN1 and RAN2 specifications are aligned and RAN1 sees no further actions needed from RAN2.**2. Actions:****To RAN2 group.****ACTION:** RAN1 respectfully asks RAN2 to take the above into account when concluding their work on half-duplex operation and does not request any further actions from RAN2.  |

## 2.4 R1-2101158

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| **Observation 1:** If half duplex behavior is expected to be enabled across all serving cells in the cell group in a frequency range, RAN2 specification should ensure directionalCollisionHandling-r16 is configured for all serving cells in the cell group in a frequency range.**Observation 2:** If directionalCollisionHandling-r16 is not required to be provided to all serving cells in the cell group in a frequency range* UE should not expect half duplex collision among the subset of serving cells not provided with directionalCollisionHandling-r16, and
* UE should not expect half duplex collision between any serving cell in the subset and the reference cell determined from the cells provided with directionalCollisionHandling-r16.

**Proposal 1:** Option 1, i.e., Half-duplex operation always apply to all TDD cells in the same cell group in a frequency range, is preferred in Rel-16. |

## 2.5 R1-2101163

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| **1. Overall Description:**RAN1 would like to thank RAN2 for the question on half-duplex operation. RAN1 would like to provide response as below.Regarding the RAN2 question on half-duplex operation whether the half-duplex operation should always apply to all TDD cells in the same cell group, or it can be chosen by network for which cells it applies within a cell group, RAN1 would like to confirm that the half-duplex operation should always apply to all TDD cells as described in 38.213.

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| If a UE - is configured with multiple serving cells and is provided *half-duplex-behavior-r16* = 'enable', and - is not capable of simultaneous transmission and reception on any of the multiple serving cells, and - indicates support of capability for half-duplex operation in CA with unpaired spectrum, and - is not configured to monitor PDCCH for detection of DCI format 2\_0 on any of the multiple serving cells, |

**2. Actions:****To RAN2 group.****ACTION:** RAN1 respectfully requests RAN2 to take the above into account.  |

## 2.6 R1-2101745

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| **Proposal 1:** DL/UL directional collision handling behavior is applicable to the cells configured with the corresponding higher-layer parameter per the current cell-based configuration. The network can choose particular cells that it applies within a cell group, while it needs to guarantee the same direction among cells in a cell group. If the configuration can be cell-group based, no issues arise from the UE capability point of view, and the network benefits from more scheduling flexibility.  |

# 3 Discussion – per cell, or per cell group?

Application of the half-duplex operation, when configured see two different alternatives.

1. Applicable to either all cell in the cell group, or none of the cells in the cell group
	1. Moderator question to the proponents: Is a specification change needed to reflect this?
2. Can be configured independently for each cell in the cell group
	1. Moderator question to the proponents: How a behaviour that is determining a behaviour when there is a directional collision between two cells applied when it is configured for one of the two cells only? Is a specification change needed to reflect this?
	2. Moderator question to the proponents: What is the use case for configuring the directional collision behaviour on for one cell, but not for another?

**Moderator proposal**:

**Please provide company views on the proposal**

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| **Company** | **Comment** |
| Nokia | Alt1: all cells in a cell group, or no cells in the cell group. There is no use case, or no obvious behavior if the operation would be configured per cell.The spec change is not strictly required, but given the discussion and the obvious need to update the RRC parameter name, it would be useful to clarify this and also add the UE capability names that are conditional to this behavior as suggested in R1-2100504 |
| vivo | As discussed in our contribution (R1-2101158), both alt1 and alt2 can work.In Alt1: Network can either configure all or none cells with *directionalCollisionHandling-r16* within the cell group having the same SCS. However, there could be cases where only a subset of cells in the cell group can actually be operated with different DL/UL directions due to the co-existence issues with adjacent channels. In this case, network has to configure all cells with *directionalCollisionHandling-r16* in order to enable the half duplex handling for the UE in some cells. This requires UE to performs duplex collision handling symbol-by-symbol in all cells even though there can never be duplex collision in the subset of cells. Alt 1 does not require RAN1 spec change (maybe some wording improvement for clarification) but requires RAN2 spec change to disallow the configuration for the subset of cells.In Alt2: The network will be able to configure a subset of cells in the cell group with *directionalCollisionHandling-r16* for the above-mentioned use cases, and in this case UE is only required to perform symbol-by-symbol duplex collision handling in the subset of cells with the configuration enabled. In the cells that are not configured with *directionalCollisionHandling-r16,* UE shall assume no duplex conflict, i.e. Rel-15 behavior. To be more specific, * UE should not expect half duplex collision among the subset of serving cells not provided with *directionalCollisionHandling-r16*, and
* UE should not expect half duplex collision between any serving cell in the subset and the reference cell determined from the cells provided with *directionalCollisionHandling-r16*.

Based on the above observation, we slightly prefer alt 1 given its minor spec impact (mostly clarification) although it seems to impose some configuration restrictions.  |
| CATT | Before discussing the two alternatives, we would like to clarify the UE capability of *half-DuplexTDD-CA-SameSCS-r16*. According to 38.306, a UE can report *half-DuplexTDD-CA-SameSCS-r16* only if *simultaneousRxTxInterBandCA* is not present.

| Definitions for parameters | Per | M | FDD-TDDDIFF | FR1-FR2DIFF |
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| ***half-DuplexTDD-CA-SameSCS-r16***Indicates whether the UE supports directional collision handling between reference and other cell(s) for half-duplex operation in TDD CA with same SCS. The UE can include this field, only if *simultaneousRxTxInterBandCA* is not present. | BC | No | TDD only | N/A |
| ***simultaneousRxTxInterBandCA***Indicates whether the UE supports simultaneous transmission and reception in TDD-TDD and TDD-FDD inter-band NR CA. It is mandatory for certain TDD-FDD and TDD-TDD band combinations defined in TS 38.101-1 [2], TS 38.101-2 [3] and TS 38.101-3 [4]. | BC | CY | N/A | N/A |

It is our understanding that *simultaneousRxTxInterBandCA* is used to indicate whether UE supports simultaneous transmission and reception in different TDD-TDD and TDD-FDD bands and a UE supports *simultaneousRxTxInterBandCA* still does not support simultaneous transmission and reception within a band. It is also our understanding that Rel-16 half-duplex operation in TDD CA is applicable to TDD intra-band CA and TDD CCs in inter-band CA with half-duplex constraint. Therefore, it is unclear to us why *simultaneousRxTxInterBandCA* should be a prerequisite of *half-DuplexTDD-CA-SameSCS-r16*. We appreciate if someone can clarify.Between the two alternatives, we prefer Alt 1 in principle for simplicity. Based on the clarification related to *simultaneousRxTxInterBandCA*, for example, if a UE can report *half-DuplexTDD-CA-SameSCS-r16* even if it supports *simultaneousRxTxInterBandCA*, we think half-duplex operation is applied to all TDD cells in each frequency band since UE can support simultaneous transmission and reception between different bands. |
| ZTE | Currently, the RAN2 signaling structure supports Alt.2 kind of configuration. Not sure whether we need to put the restriction to reduce the configuration flexibility. But anyway, we are ok with Alt.1 if majority companies prefer Alt.1 in Rel-16. |
| Huawei, HiSilicon | The alts are not strictly exclusive. Alt 1 is talking about applicability while Alt 2 is talking about configuration granularity. It is feasible that network can choose to configure some cells within a cell group, while the applicability is applied to all cells. From the operation point of view, it can be clarified that network can configure some or all cells with the RRC parameter (e.g. for signalling overhead reduction purpose), while the UE expects that collision handling is applied to all cells within the cell group. In detail,* For Alt 1, no RAN1 specification change required except for correction on RRC name. However, RAN2 specification change may be required.
* For Alt 2, there is no need to change RAN2 specifications and there is signalling overhead reduction since gNB does not need to configure all cells. However, from UE perspective, the behavior would likely be the same as UE would expect that gNB ensure no collision between the cells configured with the parameter and the cells not configured with; otherwise it is up to UE how to handle the collision.

Regarding CATT question, our view is that Rel-16 half-duplex operation does not apply to intra-band TDD CA. |
| NTT DOCOMO | We are also fine with Alt.1, and this Alt does not need to disallow the configuration for the subset of cells while the approach in R1-2100504 can allow the configuration for the subset of cells but directional collision handling is applied to all TDD cells. Such approach would be able to minimize RAN2 spec change as well as RAN1 spec change compared with introducing configuration restriction for Alt.1. |
| Ericsson | Per cell level configuration certainly provides more flexibility. If there’s both Rel-15 and Rel-16 UE in a cell, to avoid interfering the rel-15 UE caused by rel-16 UE transmitting on a undefined symbol (if I recall correctly from the long discussion of rel-16 half-duplex handling), the gNB would configure all the UEs to follow Rel-15 half-duplexing rule. Which may also explain why the prerequisite is added. If in a cell or a subset of cells where only Rel-16 UEs and above present, gNB may configure all UEs to follow the Rel-16 half-duplexing rule. From that perspective it makes sense to maintain the configuration as per cell.In our understanding Alt.2 is a better solution. |
| Qualcomm | In our view, either Alt.1 or Alt.2 can be made to work and we can accept either, with some preference towards Alt.1; however, we think that in either case it is important to clarify which Alternative is chosen. If Alt. 1 is chosen, then in our view RAN2 needs to change their specification by either changing to a single configuration parameter that is for the whole band combination or by adding a requirement that the gNB must configure consistently all those carriers that have half duplex constraint with respect to any other band/carrier in the band combination. That is, in Alt.1, either all such carriers are configured with *half-DuplexTDD-CA-SameSCS-r16* or none of them are. We would not agree with the sub-option DOCOMO was proposing, which is that the UE ‘re-interprets’ the configuration and applies it to all cells. Although this works in Rel-16, it might turn out to have forward compatibility problems. If RAN1 chooses Alt.1 in Rel-16 but for some reason chooses Alt.2 in a future release, then the DOCOMO proposal could create problems. As mentioned, we can accept Alt.2 as well. Regarding the question from the FL on how this option would work, our view is the following. Our understanding is that the directional collision handling feature is defined to operate always across pairs of cells. That is, even if the UE is configured with a CA band combination with more than two cells, the UE always applies the rules across carrier pairs. In order to do this, the UE only considers those pairs that have been indicated with no simultaneous Rx-Tx capability in *simultaneousRxTxInterBandCA* (which is reported on a per band pair per band combination basis). If a carrier is in a band that has no half-duplex restriction with respect to any other band/carrier in the CA band combination, then that carrier will be fully excluded from the directional collision handling. Therefore, we don’t think there is any further interaction needed to be considered between *simultaneousRxTxInterBandCA* and *half-DuplexTDD-CA-SameSCS-r16*, irrespective of the choice between Alt.1 and Alt.2. If Alt.2 is chosen that we believe the handling would be similar, i.e. if a particular carrier is not configured with *half-DuplexTDD-CA-SameSCS-r16*, then that carrier will be excluded from the directional handling procedure, i.e. it will not participate in any pair of carriers. In this case, the gNB has to use scheduling restriction to avoid any conflict between this carrier and any other carrier across which there is half duplex constraint. If the gNB scheduling creates a conflict, it is an error case and it is up to the UE how to handle it.  |

# 4 Conclusions

To be written