**3GPP TSG RAN WG1 #101-e R1-20xxxxx**

e-Meeting, May 25th – June 5th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on [101-e-NR-TEIs-02]

Agenda Item: 7.2.12

**Document for:** **Discussion and Decision**

# **Introduction**

This contribution summarizes the NR Rel-16 TEI related and CLI/RIM related discussions and proposals in AI 7.2.12.

[101-e-NR-TEIs-02] Email discussion/approval on remaining issues for half-duplex operation in CA

* + Whether/how to clarify the reference cell determination and confliction determination for deactivated SCell
    - Alt.1: Clarify that the reference cell is determined based on configured set of serving cells (as TP in [R1-2004259](file:///C:\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_101\Docs\R1-2004259.zip))
    - Alt.2: Clarify that RRC configured DL reception and UL transmission, for a deactivated Scell are not considered for confliction determination on configured serving cells, and UE assumes all the symbols on deactivated Scell as semi-static flexible symbol for confliction determination on configured serving cells (as TP in [R1-2003423](file:///C:\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_101\Docs\R1-2003423.zip))
  + Whether/how to cover mixed numerology case
    - Alt.1: Support the mixed numerology case (as TP in [R1-2004259](file:///C:\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_101\Docs\R1-2004259.zip))
    - Alt.2: Not support the mixed numerology case in Rel-16

By 5/29, and if potential TPs by 6/3 – Hiroki (DCM)

# **Remaining issue for half duplex operation in CA**

In [1], the following remaining issues regarding half duplex operation in CA are identified.

* If UE is configured with multiple serving cells and at least one of the serving cells is deactivated, it is not clear whether this deactivated SCell is included for DL/UL confliction determination among the configured serving cells. To avoid unnecessary dropping, all symbols on deactivated SCell can be considered as semi-static flexible symbol for confliction determination on configured serving cells.
* Similar situation occurs for dormant SCells, and hence a solution to avoid unnecessary dropping on other serving cells is necessary when dormant SCell is determined as a reference serving cell.

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| As captured in [1][2], when UE is configured with different DL/UL direction simultaneously on multiple configured serving cells, UE need to handle the collision by dropping DL reception or UL transmission. However, it is not clear whether the deactivated scell is also considered for DL/UL confilction determination. According to current specification, for a deactivated Scell, if a symbol is SFI D/U or RRC D/U according to RRC configuration, this deactivated Scell can also be determined as reference cell, and the transmission or reception on other serving cells may be dropped due to “collision” with the deactivated Scell, even if there is no actual Tx/Rx operation on the deactivated Scell.  **Observation 1: If UE is configured with multiple serving cells and at least one of the serving cells is deactivated, it is not clear whether this deactivated scell is included for DL/UL confiction determination among the configured serving cells.**  Since the DL reception and UL transmission is suspended on a deactivated scell according to TS38.321, there would be no confliction between an activated cell and deactivated scell, deactivated scell would not be considered in serving cells for DL/UL confliction determination. In this case, unnecessary dropping on other serving cells can be avoided.  **Proposal 1: Clafify that RRC configured DL reception and UL transmission, for a deactivated Scell, would not be considered for confliction determination on configured serving cells.**  According to [1][2], semi static DL and UL symbols for a scell, are also considered for confliction determination among configured serving cells. For deactivated scells, *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* can also be provided, which means transmission or reception on other serving cells may also be dropped due to semi static DL or UL configuration on deactivated Scell.  Furthermore, if a symbol is configured with semi-static flexible, and there is no RRC configured DL/UL transmissions in this symbol, this serving cell will not be the reference cell on this symbol. Thus, transmission or reception on this symbol of other serving cells would not be affected by this serving cell. Therefore, if a Scell is deactivated, all the symbols on this serving cell can be considered as flexible symbol, instead of SFI D/U. In this case, DL/UL transmission dropping on other serving cells due to “collision” with a deactivated Scell can be avoided  **Proposal 2: For a deactivated Scell, UE assumes all the symbols on deactivated Scell as semi-static flexible symbol for confliction determination on configured serving cells.**   * **Capture the TP in R1-2003423.**   Similar situation occurs for dormant Scells, in which RRC configured and dynamic scheduled UL/DL transmissions are stopped, except for CSI-RS for BFD, CSI-RS for P/SP-CSI reporting and for P-SRS with long periodicity (FFS for P-SRS) [3][4]. However, it is not clear whether the confliction handling among the serving cells is performed based on the RRC configured transmission/reception or actual UE behavior considering the restrictions on the dormant Scells in current specification. Besides, since the dynamic transmission on dormant Scells are stopped, it seems not necessary to cancel RRC D/U on other cells if symbol on dormant Scell, which is determined as reference cell, is configured as SFI U/D. In other words, if the confliction handling is performed based on RRC configuration without considering the suspended transmission/reception on dormant Scell, the transmission or reception on other serving cells may be dropped unnecessarily.  **Proposal 3: Solutions are needed to avoid unnecessary transmission/reception dropping on other serving cells when dormant Scell is determined as the reference serving cell.**  Appendix : Text proposals for Half Duplex Operation in CA  **11.1 Slot configuration**  **< Unchanged text is omitted >**  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,  the UE determines a reference cell for a symbol as a cell with the smallest cell index among serving cells where the symbol is configured as  - downlink, or uplink as indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*  - uplink, if the symbol is flexible and the UE is configured to transmit SRS, PUCCH, PUSCH, or PRACH on the symbol  - downlink, if the symbol is flexible and the UE is configured to receive PDCCH, PDSCH or CSI-RS on the  UE assumes the symbols on deactivated Scell as flexible for reference cell determination, regardless of *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated.*  **< Unchanged text is omitted >** |

In [3], the following remaining issue regarding half duplex operation in CA are identified.

* When transmission directions of multiple other cells are not aligned in case 3 or 16, UE cannot determine to follow the transmission direction of which cell. If reference cell is semi SFI D or RRC D, UE should drop high layer configured D on other cells if there is dynamic U on one of the other cells.

However, according to following conclusion made at the RAN1#100bis-e meeting, this issue does not need to be discussed.

***Conclusion:***

*The reference cell is determined with excluding the effects of UL TA and DL and UL timing differences.  
The existence of directional conflict between cells is determined with including the effects of UL TA and DL and UL timing differences.  
The error cases resulting from the discrepancy between the methods of reference cell determination and duplex direction conflict determination will not be discussed further in Rel-16. These cases include at least:  
    - duplex direction conflict between cells where both cells are reference  
    - duplex direction conflict between cells where there is no reference  
    - conflict between Dynamic D and Dynamic U*

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| According to the agreement for half-duplex UE operation, UE does not always follow reference cell transmission direction. For example, in case 3 and case 16 as shown in Table 1, UE will drop the transmission on reference cell for inter-band CA, the issue is when transmission directions of multiple other cells are not aligned, UE cannot determine to follow the transmission direction of which cell.  Table 1 Half-duplex UE behavior in different cases   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **No** | **Ref cell** | **Other cell** | **UE behavior** | **Note** | | 3 | Semi SFI D | Dynamic U | Alt 1: Allowed to drop D for inter-band  Error case in intra-band | Overriding semi SFI D to F on reference cell for the UE | | 16 | RRC D | Dynamic U | Alt 1: Allowed to drop D for inter-band  Error case in intra-band |  |   As an example shown in Table 2, if UE is configured with three cells, Pcell is configured with semi SFI D or RRC D, a dynamic U is scheduled on Scell 1 and RRC D is configured on Scell2. Then, according to the agreement, Pcell is the reference cell, UE should drop D on reference cell and transmit dynamic U on Scell1, but there is no conflict between Pcell and Scell2, it is not clear whether a half-duplex UE should drop dynamic U on Scell 1 or drop RRC D on Scell 2. From our perspective, UE should prioritize dynamic U on Scell1 in this case according to the principle of case 3 and case 16.  Table 2 Conflict direction on Scells   |  |  |  |  | | --- | --- | --- | --- | | **Pcell (Reference cell)** | **Scell1** | **Scell2** | **UE behavior** | | Semi SFI D | Dynamic U | RRC D | drop D or drop U? | | RRC D | Dynamic U | RRC D | drop D or drop U? |   ***Proposal 1: For a half-duplex CA UE, if reference cell is semi SFI D or RRC D, UE should drop high layer configured D on other cells if there is dynamic U on one of the other cells.***  In addition, the agreements for inter-band CA case are not correctly captured in the specification. Hence, a text proposal is provided below for half-duplex operation in CA in 38.213 section 11.1.  -------------------------------------------------- Start of text proposal ------------------------------------------------------  If the reference cell and another cell for a UE operate in different frequency bands and if the UE  - is configured with multiple serving cells and is provided *half-duplex-behavior-r16* = 'enable',  - is not capable of simultaneous transmission and reception on any of the multiple serving cells,  - 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,  the UE  - UE assumes symbol on the other cell as flexible, is not required to receive higher layer configured PDCCH, PDSCH, or CSI-RS and not expected to transmit higher layers configured SRS, PUCCH, PUSCH, or PRACH, when *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* indicates symbol as downlink or uplink on the other cell and as uplink or downlink for the reference cell, respectively,  - transmits a signal/channel on a symbol of the other cell and is not required to receive a higher layer configured PDCCH, PDSCH, or CSI-RS on the symbol on the reference cell and any of the other cells when the symbol is indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigDedicated* for the reference cell and if the UE detects a DCI format scheduling the transmission on the symbol on the other cell,  - transmits a signal/channel on a symbol of the other cell and is not required to receive a higher layer configured PDCCH, PDSCH, or CSI-RS on the symbol on the reference cell and any of the other cells, if the symbol on the reference cell is flexible and the UE is configured by higher layers to receive PDCCH, PDSCH, or CSI-RS on the symbol on the reference cell and the UE detects a DCI format scheduling the transmission on the symbol on the other cell.  ----------------------------------------------------- End of text proposal ------------------------------------------------------ |

In [7], the following remaining issues regarding half duplex operation in CA are identified.

* If UE is configured with multiple serving cells and at least one of the serving cells is deactivated, it is not clear whether this deactivated SCell can be reference cell. To simplify already quite complicated feature, it is proposed to determine reference cells among configured cells.
* The support of the mixed numerology case remains open. It is proposed to support the case by defining the reference cell as cell with lowest SCS among cells for which the symbols (configured as RRC D/U or semi SFI D/U) are overlapping.

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| The issue of deactivated Scell. The question is whether deactivated Scell can be reference cell. Obviously if Scell is deactivated, direcitonal conflict cannot happen. On the other hand, it was assumed that reference cell is determined based on configuration, and Scell-activation/deactivation would result in change of reference cell dynamically based on MAC-CE command. To simplify already quite complicated feature, we propose to determine reference cells among configured cells.  **Proposal 1**: *Adopt the below TP for TS38.213 to clarify that reference cell is determined based on configured set of serving cells.*   |  | | --- | | 11 UE-group common signalling  If the UE is configured with a SCG, the UE shall apply the procedures described in this clause for both MCG and SCG  - When the procedures are applied for MCG, the terms 'secondary cell', 'secondary cells', 'serving cell', 'serving cells' in this clause refer to secondary cell, secondary cells, serving cell, serving cells belonging to the MCG respectively.  - When the procedures are applied for SCG, the terms 'secondary cell', 'secondary cells', 'serving cell', 'serving cells' in this clause refer to secondary cell, secondary cells (not including PSCell), serving cell, serving cells belonging to the SCG respectively. The term 'primary cell' in this clause refers to the PSCell of the SCG.  11.1 Slot configuration  <unchanged text omitted >  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,  the UE determines a reference cell for a symbol as a configured cell with the smallest cell index among serving cells where the symbol is configured as  - downlink, or uplink as indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*  - uplink, if the symbol is flexible and the UE is configured to transmit SRS, PUCCH, PUSCH, or PRACH on the symbol  -downlink, if the symbol is flexible and the UE is configured to receive PDCCH, PDSCH or CSI-RS on the symbol.  <unchanged text omitted > |   ~  The mixed numerology case (which remained open after RAN1#100e) can be handled by defining the reference cell as cell with lowest SCS among cells for which the symbols (configured as RRC D/U or semi SFI D/U) are overlapping.  **Proposal 2:** *Consider to support mixed numerology scenario for half-duplex feature, consider adopting the following TP for TS 38.213.*   |  | | --- | | 11 UE-group common signalling  If the UE is configured with a SCG, the UE shall apply the procedures described in this clause for both MCG and SCG  - When the procedures are applied for MCG, the terms 'secondary cell', 'secondary cells', 'serving cell', 'serving cells' in this clause refer to secondary cell, secondary cells, serving cell, serving cells belonging to the MCG respectively.  - When the procedures are applied for SCG, the terms 'secondary cell', 'secondary cells', 'serving cell', 'serving cells' in this clause refer to secondary cell, secondary cells (not including PSCell), serving cell, serving cells belonging to the SCG respectively. The term 'primary cell' in this clause refers to the PSCell of the SCG.  11.1 Slot configuration  <unchanged text omitted >  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,  the UE determines a reference cell for a symbol of the lowest sub-carrier spacing as a cell with the smallest sub-carrier spacing first and with the smallest cell index among serving cells second where the symbol or at least one of overlapping symbols is configured as  - downlink, or uplink as indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*  - uplink, if the symbol is flexible and the UE is configured to transmit SRS, PUCCH, PUSCH, or PRACH on the symbol  -downlink, if the symbol is flexible and the UE is configured to receive PDCCH, PDSCH or CSI-RS on the symbol.  <unchanged text omitted > | |

Based on above, following remaining issues for half-duplex operation in CA should be discussed in RAN1#101-e meeting.

* **Whether/how to clarify the reference cell determination and confliction determination for deactivated SCell**
  + **Alt.1: Clarify that the reference cell is determined based on configured set of serving cells (as TP in R1-2004259)**
  + **Alt.2: Clarify that RRC configured DL reception and UL transmission, for a deactivated Scell are not considered for confliction determination on configured serving cells, and UE assumes all the symbols on deactivated Scell as semi-static flexible symbol for confliction determination on configured serving cells (as TP in R1-2003423)**
* **Whether/how to cover mixed numerology case**
  + **Alt.1: Support the mixed numerology case (as TP in R1-2004259)**
  + **Alt.2: Not support the mixed numerology case in Rel-16**

Regarding the first discussion point on whether/how to clarify the reference cell determination and confliction determination for deactivated SCell, the FL proposal is to adopt Alt.1 considering its simplicity compared with Alt.2.

**FL proposal 1:**

* **Clarify that the reference cell is determined based on configured set of serving cells**
  + **Adopt the TP of proposal 1 in R1-2004259**

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals: vivo

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| Company | Comment |
| vivo | We do not agree with the proposal.  Alt 1 does not makes sense to include the deactivated Scell (and its RRC configured DL and UL)  into the reference cell determination. Currently the UE is already required to determine the  reference cell per symbol and at each determination UE clearly knows which Scell is active or de-  active, therefore we do not see the complexity increase by excluding deactivated Scell for the  reference determination (by assuming all flexible symbols in the deactivated Scell so that the  deactivated Scell will never become reference cell) |
| Qualcomm | We can accept the proposal. Our understanding is that only the configured D and U symbols matter in a deactivated SCell, so whether it is included or not makes little actual difference. Including deactivated SCells seems somewhat simpler. |
| Nokia, NSB | Currently UE determined reference cell per symbol, but based on RRC configuration. So UE/gNB has to determine cell per each combination of active/deactive Scell. Or determine reference cell on fly. Given that feature is already quite complex, we prefer Alt.1. However, if Alt.2 should be selected, then TP should be the following  the UE determines a reference cell for a symbol as an active cell with the smallest cell index among serving cells where the symbol is configured as |
| Ericsson | We are fine with the FL proposal. Note that we are in maintenance phase. The discussions of this TEI have been lasting for long since Rel-15. Over optimization appears not justified. |

Based on further discussion, following updated FL proposal 1 is made.

**Updated FL proposal 1:**

* **Adopt the following TP**

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| 11.1 Slot configuration  <unchanged text omitted >  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,  the UE determines a reference cell for a symbol as an active cell with the smallest cell index among serving cells where the symbol is configured as  -     downlink, or uplink as indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*  -     uplink, if the symbol is flexible and the UE is configured to transmit SRS, PUCCH, PUSCH, or PRACH on the symbol  -downlink, if the symbol is flexible and the UE is configured to receive PDCCH, PDSCH or CSI-RS on the symbol.  <unchanged text omitted > |

Regarding the second discussion point on whether/how to cover mixed numerology case, the FL proposal is to adopt Alt.2 considering past discussions and discussion in UE features session as in [101-e-NR-UEFeatures-TEIs-01].

**FL proposal 2:**

* **Not support the mixed numerology case for HD operation in CA in Rel-16**

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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| Company | Comment |
| vivo | We have no strong view, can accept the proposal. |
| Qualcomm | Agree with the proposal |
| Nokia, NSB | Given the phase of maintenance, we are fine with the proposed conclusion. |
| Ericsson | We support the FL proposal. |

# **Conclusion**

**Updated FL proposal 1:**

* **Adopt the following TP**

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| 11.1 Slot configuration  <unchanged text omitted >  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,  the UE determines a reference cell for a symbol as an active cell with the smallest cell index among serving cells where the symbol is configured as  -     downlink, or uplink as indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*  -     uplink, if the symbol is flexible and the UE is configured to transmit SRS, PUCCH, PUSCH, or PRACH on the symbol  -downlink, if the symbol is flexible and the UE is configured to receive PDCCH, PDSCH or CSI-RS on the symbol.  <unchanged text omitted > |

**FL proposal 2:**

* **Not support the mixed numerology case for HD operation in CA in Rel-16**

# **References**

[1] R1-2003423 Remaining issues on Half-Duplex Operation in CA vivo

[2] R1-2003492 Remaining issues on CLI ZTE

[3] R1-2003610 Remaining issues of half-duplex operation in CA CATT

[4] R1-2003692 On TRS muting for NR coexistence with a narrow band system MediaTek Inc.

[5] R1-2003763 Maintenance of aperiodic CSI-RS triggering with beam switching timing of 224 and 336 Intel Corporation

[6] R1-2003923 On ambiguous TBS due to ambiguity of Ninfo NEC

[7] R1-2004259 On remaining issues of HD UE feature Nokia, Nokia Shanghai Bell

[8] R1-2004604 Discussion on the conditions of rate matching pattern overlapping with PDSCH DMRS symbols Huawei, HiSilicon

[9] R1-2004642 Remaining issue for Rel-16 maintenance Ericsson