3GPP TSG RAN WG1 #103-e R1-20xxxxx

e-Meeting, October 26th – November 13th, 2020

**Agenda item: 5.1**

**Source: Moderator (China Telecom)**

**Title: [103-e-NR-LS-TxSwitching-01] Email discussion/approval on maintenance of uplink Tx switching thread #1**

**Document for: Discussion and Decision**

# Introduction

In [1], maintenance issues are summarized for uplink Tx switching. As per the guidance of Chairman, following issues are identified for email discussion/approval during RAN1 #103 e-meeting:

[103-e-NR-LS-TxSwitching-01] Email discussion/approval a potential CR till 10/30 – Jianchi (CT)

* Clarification on T^mux\_{proc,CSI} (R1-2007603, R1-2007725, R1-2008564)
* Clarification on the ambiguity issue on SCS and align the description on carrier1 and carrier2 with TS 38.331 (R1-2007725, R1-2008229)

[103-e-NR-LS-TxSwitching-02] Email discussion/approval a potential CR till 10/30 – Jianchi (CT)

* Back to back switching caused by SRS transmission (R1-2008596)
  + Note 1: no discussion on location of switching period.
  + Note 2: the previous agreements should not be overturned.
* Maximum data rate (R1-2008596)

This contribution is the summary of email discussion/approval on maintenance of uplink Tx switching thread #1.

# Discussion

## Issue #1: Clarification on (R1-2007603, R1-2007725, R1-2008564)

During the RAN1#101-e meeting, following agreement related to the additional time due to triggered UL switching for has been achieved:

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| **Agreement:** Confirm the following work assumption:  Working assumption:   * If uplink Tx switching is triggered, the additional time is needed and it equals to the length of UL switching period for the followings cases:   + Aperiodic SRS transmission   + PDCCH order triggered PRACH transmission   + in case of CSI triggered with Z1 of Table 5.4-1 of TS 38.214 |

Based on the above agreement, the additional time due to triggered UL switching for has been captured in TS 38.213. R1-2007603 mentioned the current description in TS 38.213 is ambiguous and proposed two alternatives to revise the TS 38.213:

**Alt. 1:** Delete the from the definition of in TS 38.213 so that always equals to zero for all the cases of the determination of .

* **Proposed TP to TS 38.213**

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| 9.2.5 UE procedure for reporting multiple UCI types  **< unchanged text omitted>**  If there is at least one PUSCH in the group of overlapping PUCCHs and PUSCHs, is given by maximum of where for the i-th PUSCH which is in the group of overlapping PUCCHs and PUSCHs, , , are selected for the i-th PUSCH following [6, TS 38.214], is selected based on the UE PUSCH processing capability of the i-th PUSCH and SCS configuration , where corresponds to the smallest SCS configuration among the SCS configurations used for the PDCCH scheduling the i-th PUSCH, the PDCCHs scheduling the PDSCHs or providing the SPS PDSCH releases with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs/PUSCHs, and all PUSCHs in the group of overlapping PUCCHs and PUSCHs.  **< unchanged text omitted>** |

**Alt. 2:** Clarify the non-zero should be applied for the determination of only if of table 5.4-1 in TS 38.214 is applied for the determination of .

* **Proposed TP to TS 38.213**

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| 9.2.5 UE procedure for reporting multiple UCI types  **< unchanged text omitted>**  - , , , , , and are defined in [6, TS 38.214], is applied only if of table 5.4-1 in [6, TS 38.214] is applied to the determination of , and and are defined in [4, TS 38.211].  **< unchanged text omitted>** |

Companies are invited to provide views on the above two TPs.

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| **Companies** | **Comments** |
| ZTE | We prefer Alt.1 if companies especially UE vendors think that the current timeline is sufficient. |
| Huawei, HiSilicon | Since an agreement has been made to have for CSI computation time only in case of (of table 5.4-1 of TS 38.214), it is reasonable to have such additional time also for UCI multiplexing on PUSCH conveying CSI report with the same restriction, i.e. only in case of . Because it is possible to trigger SR (e.g. for SCell beam failure recovery) on PUCCH without HARQ-ACK, the and SR may be multiplexed into PUSCH carrying CSI, of table 5.4-1 of TS 38.214 is a valid case and applicable to , therefore, we prefer Alt. 2.  But if companies prefer to preclude the SR case, then Alt.1 is needed. The current TP for Alt.1 does not match well with the Alt.1 proposal, sorry for it. Here is an update for Alt.1 TP, in which it is the rather than that should be corrected.  9.2.5 UE procedure for reporting multiple UCI types  **< unchanged text omitted>**  - if there is an aperiodic CSI report multiplexed in a PUSCH in the group of overlapping PUCCHs and PUSCHs, is not before a symbol with CP starting after after a last symbol of  - any PDCCH with the DCI format scheduling an overlapping PUSCH, and  - any PDCCH scheduling a PDSCH, or SPS PDSCH release, or providing a DCI format 1\_1 indicating SCell dormancy, or a DCI format 1\_1 indicating a request for a Type-3 HARQ-ACK codebook report without scheduling PDSCH, with corresponding HARQ-ACK information in an overlapping PUCCH in the slot  where corresponds to the smallest SCS configuration among the SCS configuration of the PDCCHs, the smallest SCS configuration for the group of the overlapping PUSCHs, and the smallest SCS configuration of CSI-RS associated with the DCI format scheduling the PUSCH with the multiplexed aperiodic CSI report, and for , for and for  **< unchanged text omitted>** |
| Qualcomm | After the explanation by Huawei, although the handling of SR is a bit unclear, for the time being we prefer Alt.2 because it would cover all possibilities. |
| CATT | Either Alt.1 or Alt.2 is fine to us. But as pointed out by Huawei, the proposed TP for Alt.1 seems incorrect. |
| FL | It seems Alt.2 can be accepted by the majority. |
| Intel | We Support Alt.2 |

R1-2008564 mentioned the PUSCH processing time for inter-band UL CA Option 2 with UL Tx switching based on *µUL* = min (*µUL, CC1*, *µUL, CC2*) is not reflected for case of computation when UCI is multiplexed on PUSCH.

* **Proposed TP to TS 38.213**

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| 9.2.5 UE procedure for reporting multiple UCI types  **< unchanged text omitted>**  If there is at least one PUSCH in the group of overlapping PUCCHs and PUSCHs, is given by maximum of where for the i-th PUSCH which is in the group of overlapping PUCCHs and PUSCHs, , , and are selected for the i-th PUSCH following [6, TS 38.214], is selected based on the UE PUSCH processing capability of the i-th PUSCH and SCS configuration , where  corresponds to the smallest SCS configuration among the SCS configurations used for the PDCCH scheduling the i-th PUSCH, the PDCCHs scheduling the PDSCHs or providing the SPS PDSCH releases with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs/PUSCHs, and all PUSCHs in the group of overlapping PUCCHs and PUSCHs, and where if UE is configured with *dualUL* by the parameter *uplinkTxSwitchingOption-r16* for uplink carrier aggregation and if a PUSCH in the group of overlapping PUCCHs and PUSCHs is on one of the two uplink carriers described in subclause 6.1.6.2 of [6, TS38.214], the SCS configuration min(*µUL,carrier1, µUL,carrier2*) is used instead of SCS configuration for the PUSCH, where *µUL,carrier1* and *µUL,carrier2* are defined in [6, TS38.214].  **< unchanged text omitted>** |

Companies are invited to provide views on the above proposed TP.

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| **Companies** | **Comments** |
| ZTE | If Alt.1 is adopted for the above issue, then this TP is not needed.  If Alt.2 is adopted, then we can further discuss whether the TP is correct or not. From our perspective, this TP is not correct. Min(u\_1, u\_2) is only applied when UL Tx switching is performed. However, the above TP seems to say that Min(u\_1, u\_2) is applied even when no UL Tx switching is performed. |
| Huawei, HiSilicon | We don’t feel the CR is needed for the following reasons,   * the agreement for the SCS minimization of UL-CA “Option 2” was made for PUSCH transmission rather than the UCI multiplexing * the SCS minimization of UL-CA “Option 2” for PUSCH transmission is between the current PUSCH transmission and the previous transmission, however, the SCS in the processing time formula is between current PUSCH transmission and current overlapping PUCCH transmission. There is no UL Tx switching between current PUSCH transmission and current overlapping PUCCH transmission, thus no need of additional SCS minimization. With the key difference, the agreement cannot be applied to the SCS of UCI multiplexing. The necessity of the TP is unclear. |
| Qualcomm | Agree with the text proposal. We understand that the switching may change the multiplexing decision itself, based on UE implementation, therefore the additional time is needed. |
| Ericsson | Support the TP. To address ZTE comment, can add the condition “if uplink switching gap is triggered as defined in clause 6.1.6 for transmission of the PUSCH, the SCS configuration min(*µUL,carrier1, µUL,carrier2*) is used”. |
| FL | @ZTE, @Huawei, please check the latest proposal from Ericsson. |
| Intel | We support the TP. |
| ZTE | Although we prefer not to have this TP, we can accept if this is the majority view. We are ok with the updated TP from Ericsson. |
| Huawei, HiSilicon | @FL, Sorry but we don’t see Ericsson’s reply addresses any our concerns. Please let us know if we miss anything.  In addition, we would like to remind the motivation of SCS minimization for “UL-CA Option 2”. It was to avoid the waveform distortion on the immediately preceding transmission caused by UL tx switching according to one company’s request. However, there is no such preceding transmission involved in the UCI multiplexing operation. It is unclear why the SCS for current UCI on PUCCH and current PUSCH needs a change. |
| Ericsson2 | To follow up on Huawei’s comment, with the updated TP, it is about preparation involving a PUSCH transmission for which UL switching gap is triggered (i.e. by if uplink switching gap is triggered as defined in clause 6.1.6 for transmission of the PUSCH,) and that PUSCH is involved in multiplexing decision with other PUCCH/PUSCH. If it is common understanding that tighter UE processing timeline applies for such case, the CR is not needed, and we can capture that understanding e.g. as a conclusion. Otherwise, CR is needed. |

## Issue #2: Clarification on the ambiguity issue on SCS and align the description on carrier1 and carrier2 with TS 38.331 (R1-2007725, R1-2008229)

During RAN1#101e, the following agreements were reached.

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| **Agreements:**   * + For inter-band UL CA, SUL and EN-DC, a UE does not expect to perform more than one UL Tx switching in a slot with larger SCS between two uplink carriers. |

R1-2007725 mentioned the current description in TS 38.214 is not clear due to the following two reasons.

(1) The “subcarrier spacing of the uplink transmitted before the switching gap” and “subcarrier spacing of the uplink transmitted after the switching gap” are ambiguous in case when there are UL transmissions in both carriers, especially when the subcarrier spacings of the uplink transmitted in these two carriers are different.

(2) The SCS of the uplink carrier should be determined by the SCS of the active UL BWP, instead of the uplink transmission. If the uplink transmission is PRACH, the SCS of the uplink transmission (i.e., PRACH) may be different from the SCS of the active UL BWP.

* **Proposed TP to TS 38.214**

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| 6.1.6 Uplink switching  **< unchanged text omitted>**  The UE does not expect to perform more than one uplink switching in a slot with *µUL* = max(*µUL,carrier1, µUL,carrier2*), where the *µUL,carrier1* corresponds to the subcarrier spacing of the active UL BWP of one uplink carrier and the *µUL,carrier2* corresponds to the subcarrier spacing of the active UL BWP of the other uplink carrier.  **< unchanged text omitted>** |

Companies are invited to provide views on the above proposed TP.

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| **Companies** | **Comments** |
| ZTE | We are supportive of this TP. Without this TP, it is not clear how to interpret this spec in case of 1P+1P transmission. For example, if 1P+1P transmission is before the switching gap, then how to interpret “subcarrier spacing of the uplink transmitted before the switching gap”?  Another way is to adopt the following TP, which is in line with the intention of R1-2008229, i.e., to clarify the interpretation of *carrier1* and *carrier2*.  The UE does not expect to perform more than one uplink switching in a slot with *µUL* = max(*µUL,carrier1, µUL,carrier2*), where the *µUL,carrier1* corresponds to the subcarrier spacing of the active UL BWP of the uplink carrier configured with *carrier1* and the *µUL,carrier2* corresponds to the subcarrier spacing of the active UL BWP of the uplink carrier configured with *carrier2*. |
| Huawei, HiSilicon | It is quite unfortunate that the proposal is not based on the latest converged version of last meeting, which would trigger unnecessary reiteration of previous comments and waste all the efforts we had.  Therefore, we suggest to start with the latest converged version and make a quite agreement    Adopt the following TP to TS 38.214.   |  | | --- | | 6.1.6   Uplink switching  **< unchanged text omitted>**  The UE does not expect to perform more than one uplink switching in a slot withµUL= max(µUL,carrier1, µUL,carrier2),where theµUL,carrier1 corresponds to the subcarrier spacing of the active UL BWP of one uplink carrier ~~uplink transmitted~~before the switching gap and the µUL,carrier2 corresponds to the subcarrier spacing of the active UL BWP of the other uplink carrier~~uplink transmitted~~after the switching gap.  **< unchanged text omitted>** |   We don’t see a necessity to involve RRC IE value *carrier1* and *carrier2* here and prefer to minimize the spec change. |
| Qualcomm | Agree with the text proposal. Strictly speaking, the Huawei proposal also works but it is expected to raise questions what a carrier before the gap or carrier after the gap are once the word “transmitted” is deleted. Both UL carriers (or more than two UL carriers for UL CA with >2 UL CCs) are by definition both before and after the gap. Therefore, the way of selecting one or another is unclear. Further comment below on the usage of the terms carrier1 and carrier2. |
| CATT | Ok with the TP. |

R1-2008229 mentioned there is misalignment between TS 38.214 and TS 38.331 regarding *carrier1* and *carrier2*.

* **Proposed TP to TS 38.214**

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| 6.1.6 Uplink switching  **< unchanged text omitted>**  The UE does not expect to perform more than one uplink switching in a slot with *µUL* = max(*µUL,carrier1, µUL,carrier2*), where the *µUL,carrier1* corresponds to the subcarrier spacing of ~~the~~ one uplink carrier ~~transmitted before the switching gap~~ and the *µUL,carrier2* corresponds to the subcarrier spacing of ~~the~~ another uplink carrier ~~transmitted after the switching gap~~.  **< unchanged text omitted>** |

Companies are invited to provide views on the above proposed TP.

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| **Companies** | **Comments** |
| ZTE | The intention of this TP is in line with our TP in R1-2007725. For this TP, to make it clear, we prefer to say “subcarrier spacing of the active UL BWP” instead of “subcarrier spacing of one uplink carrier”.  Another way is to adopt the following TP, which is in line with the intention of R1-2008229, i.e., to clarify the interpretation of *carrier1* and *carrier2*.  The UE does not expect to perform more than one uplink switching in a slot with *µUL* = max(*µUL,carrier1, µUL,carrier2*), where the *µUL,carrier1* corresponds to the subcarrier spacing of the active UL BWP of the uplink carrier configured with *carrier1* and the *µUL,carrier2* corresponds to the subcarrier spacing of the active UL BWP of the uplink carrier configured with *carrier2*. |
| Huawei, HiSilicon | The subscript carrier1 and carrier2 in *µUL* here are just to differentiate two carriers as usual but have no connection with the RRC IE value *carrier1* and *carrier2* whose description in TS 38.331 is referred to TS 38.101-x instead of TS 38.214.  Therefore, we are afraid that a necessity for the TP is unclear and the TP is not needed. |
| Qualcomm | * The issue mentioned above is valid, but there is another misalignment in TS38.306 as carrier2 is always 2-port CC.   ***ULTxSwitchingBandPair-r16***  Indicates UE supports dynamic UL Tx switching in case of inter-band CA, SUL, and (NG)EN-DC as defined in TS 38.214 [12], TS 38.101-1 [2] and TS 38.101-3 [4]. The capability signalling comprises of the following parameters:  - *bandIndexUL1-r16* and *bandIndexUL2-r16* indicate the band pair on which UE supports dynamic UL Tx switching. *bandindexUL1*/*bandindexUL2* xx refers to the xxth band entry in the band combination. UE shall indicate support for 2-layer UL MIMO capabilities at least on one of the indicated two bands for UL Tx switching, and only the band where UE supports 2-layer UL MIMO capability can work as carrier2 as defined in TS 38.101-1 [2] and TS 38.101-3 [4].  ***uplinkTxSwitching-PowerBoosting-r16***  Indicates the support of 3dB boosting on the maximum output power for UE transmission under the operation state in which 2-port transmission can be supported on carrier2 in case of inter-band UL CA case where UE supports dynamic UL Tx switching. A UE shall only indicate this capability in case the UE supports power class 3 for inter-band UL CA for the band combination as defined in TS 38.101-1 [2].   * Proposal from QC: as CC2 is assumed as 2-port CC in the spec by the leading WG – RAN4, propose to align with RAN4 wording.  |  | | --- | | TP from QC  The UE does not expect to perform more than one uplink switching in a slot with *µUL* = max(*µUL,carrier1, µUL,carrier2*), where the *µUL,carrier1* corresponds to the subcarrier spacing of the uplink carrier with maximum 1-port transmission ~~transmitted~~ ~~before the switching gap~~ and the *µUL,carrier2* corresponds to the subcarrier spacing of the uplink carrier with maximum 1-port transmission ~~transmitted after the switching gap~~. | |

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| **Companies** | **Comments** |
| FL | It seems that above TPs for issue #2 can be discussed together.  Based on comments, TP is revised as follows:  **< unchanged text omitted>**  The UE does not expect to perform more than one uplink switching in a slot with *µUL* = max (*µUL,carrier1, µUL,carrier2*), where the *µUL,carrier1* corresponds to the subcarrier spacing of the active UL BWP of one uplink carrier with maximum 1-port transmission ~~uplink transmitted before the switching gap~~ and the *µUL,carrier2* corresponds to the subcarrier spacing of the active UL BWP of the other uplink carrier with maximum 2-port transmission ~~uplink transmitted after the switching gap~~.  **< unchanged text omitted>** |
| Intel | We are supportive for the updated FL proposal |
| ZTE | We are fine with the updated FL proposal. |
| Huawei, HiSilicon | As commented before, there is no connection between the subscript and the RRC parameters because its meaning is clearly described as “corresponds to the subcarrier spacing”. If companies prefer a clarification, a better one is simply to replace the subscript “carrier1” with “1”, similarly for “carrier2”.  The FL’s text change seems to introduce more ambiguity and restriction. We prefer to keep the RAN1 spec be generic.  Fine to combine two TPs for discussions, however, for the other text change, we still require to start with what we left last meeting as commented to the other TP.  i.e.    Adopt the following TP to TS 38.214.   |  | | --- | | 6.1.6   Uplink switching  **< unchanged text omitted>**  The UE does not expect to perform more than one uplink switching in a slot withµUL= max(µUL,1, µUL,2),where theµUL,1 corresponds to the subcarrier spacing of the active UL BWP of one uplink carrier ~~uplink transmitted~~before the switching gap and the µUL,2 corresponds to the subcarrier spacing of the active UL BWP of the other uplink carrier~~uplink transmitted~~after the switching gap.  **< unchanged text omitted>** | |
| CATT | TP from Huawei is ambiguous in our view. Considering an example in the following figure. After the first switching gap, SCS of Carrier 1 is changed to 30kHz. There are two different SCS after the first switching gap. Which SCS is used in this case? If 15kHz is used, then the second switching period is not allowed. If 30kHz SCS is used, then the second switching period is allowed. In our view, the SCS at the same time instant shall be used, but not before and after a switching period. |

# References

1. R1-2008814, Summary of uplink Tx switching, Moderator (China Telecom), RAN1#103e, October 26th – November 13th, 2020.
2. R1-2007603, Discussion on the remaining problems of supporting Tx switching between two uplink carriers, Huawei, HiSilicon, October 26th – November 13th, 2020.
3. R1-2007725, Remaining Maintenance Issues of UL Tx Switching, ZTE, October 26th – November 13th, 2020.
4. R1-2008229, Text Proposals for Tx Switching between Two Uplink Carriers, OPPO, October 26th – November 13th, 2020.
5. R1-2008564, Draft CR to 38.213 on corrections for UL Tx switching, Ericsson, October 26th – November 13th, 2020.
6. R1-2008596, Remaining issues for 1Tx-2Tx switching, Qualcomm Incorporated, October 26th – November 13th, 2020.

# Appendix

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| **Companies** | **Views** |
| **Huawei**  **(R1-2007603)** | ***Proposal****:* *Adopt the TP1 or TP2 for in Appendix for the following two alternatives, respectively:*   * *Alt. 1: Delete the from the definition of in TS 38.213 so that always equals to zero for all the cases of the determination of , and*   + *Adopt TP1 in Appendix.* * *Alt. 2: Clarify the non-zero should be applied for the determination of only if of table 5.4-1 in TS 38.214 is applied for the determination of , and*   + *Adopt TP2 in Appendix.* |
| **ZTE**  **(R1-2007725)** | ***Proposal 1****: Adopt the following TP1 for 38.214 UL Tx switching.*  ***TP1****: {38.214, 6.1.6 Uplink switching}*   |  | | --- | | <---------------------------- Other parts omitted ---------------------------->  If an uplink switching is triggered for an uplink transmission starting at *T0*, after *T0-Toffset*, the UE is not expected to cancel the uplink switching, or to trigger any other new uplink switching occurring before *T0* for any other uplink transmission that is scheduled after *T0-Toffset*, where *Toffset* is the UE processing procedure time defined for the uplink transmission triggering the switch given in subclause 5.3, subclause 5.4, subclause 6.2.1, subclause 6.4 and in subclause 9 of [6, TS 38.213].  The UE does not expect to perform more than one uplink switching in a slot with *µUL* = max(*µUL,carrier1, µUL,carrier2*), where the *µUL,carrier1* corresponds to the subcarrier spacing of the active UL BWP of one uplink carrier and the *µUL,carrier2* corresponds to the subcarrier spacing of the active UL BWP of the other uplink carrier.  <---------------------------- Other parts omitted ----------------------------> |   ***Proposal 2****: Consider the following two alternatives to address the back-to-back switching issue.*  *Alternative#1: The UE does not expect to perform an uplink switching if the gap between the start of this uplink switching and the end of the previous uplink switching is smaller than 1 symbol based on numerology µUL*  *Alternative#2: The switching gap can only be placed at the slot boundary or the switching point for S slot.*  ***Proposal 3****: Tswitch is not needed for the case of SR+Aperioidc CSI multiplexing on PUSCH.* |
| **OPPO**  **(R1-2008229)** | |  | | --- | | 6.1.6 Uplink switching  **< unchanged text omitted>**  The UE does not expect to perform more than one uplink switching in a slot with *µUL* = max(*µUL,carrier1, µUL,carrier2*), where the *µUL,carrier1* corresponds to the subcarrier spacing of ~~the~~ one uplink carrier ~~transmitted before the switching gap~~ and the *µUL,carrier2* corresponds to the subcarrier spacing of ~~the~~ another uplink carrier ~~transmitted after the switching gap~~.  **< unchanged text omitted>** | |
| **Ericsson**  **(R1-2008564)** | 9.2.5 UE procedure for reporting multiple UCI types  **< unchanged text omitted>**  If there is at least one PUSCH in the group of overlapping PUCCHs and PUSCHs, is given by maximum of where for the i-th PUSCH which is in the group of overlapping PUCCHs and PUSCHs, , , and are selected for the i-th PUSCH following [6, TS 38.214], is selected based on the UE PUSCH processing capability of the i-th PUSCH and SCS configuration , where corresponds to the smallest SCS configuration among the SCS configurations used for the PDCCH scheduling the i-th PUSCH, the PDCCHs scheduling the PDSCHs or providing the SPS PDSCH releases with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs/PUSCHs, and all PUSCHs in the group of overlapping PUCCHs and PUSCHs, and where if UE is configured with *dualUL* by the parameter *uplinkTxSwitchingOption-r16* for uplink carrier aggregation and if a PUSCH in the group of overlapping PUCCHs and PUSCHs is on one of the two uplink carriers described in subclause 6.1.6.2 of [6, TS38.214], the SCS configuration min(*µUL,carrier1, µUL,carrier2*) is used instead of SCS configuration for the PUSCH, where *µUL,carrier1* and *µUL,carrier2* are defined in [6, TS38.214].  **< unchanged text omitted>** |