**3GPP TSG- Meeting # *25xxxxx***

**Bengaluru, India, 25th – 29th Aug 2025**

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| *CR-Form-v12.3* |
| **Draft CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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|  |
| ***Title:***  | TEI19 UL Tx switching for 3Tx UEs |
|  |  |
| ***Source to WG:*** |  |
| ***Source to TSG:*** | R1 |
|  |  |
| ***Work item code:*** | TEI19 |  | ***Date:*** | 2025-09-10 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** |  |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
|  |  |
| ***Reason for change:*** | Several changes agreesdin RAN1#122 as described in R1-2506463.* A UE capable of Scenario#1 is mandated to support max 2 layers of UL-MIMO on carriers of both bands.
* For a UE capable of Scenario#1, the number of ports of UL-MIMO can be configured as either 1-port or 2-port on any UL carriers as usual. If 1-port is configured on all the carriers of any band, then the UE behaviour follows the normal UL-CA.
* Inform RAN2/RAN4 with the following:
	1. The following RRC parameters are used to configure 3Tx Scenario#1;
		+ *uplinkTxSwitching*: existing RRC parameter in R16/R17 UL Tx switching.
		+ [*uplinkTxSwitching3TxScenario1*]: new RRC parameter to configure the UE with 3Tx Scenario#1.
	2. The following RRC parameters are not applicable when the UE is configured with [*uplinkTxSwitching3TxScenario1*];
		+ *uplinkTxSwitchingOption*
		+ *uplinkTxSwitching-2T-Mode*
		+ *uplinkTxSwitching-DualUL-TxState*
	3. Note: the following UE capability is assumed to be introduced by RAN4:
		+ [*uplinkTxSwitchingPeriod3TxScenario1*]*:* UE capability to report the support of 3Tx Scenario#1 and the switching period required for 3Tx Scenario#1
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| ***Summary of change:*** | Implemented changes to reflect the above agreements! |
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| ***Consequences if not approved:*** |  |
|  |  |
| ***Clauses affected:*** | 6.1.6, 6.1.6.2.0, 6.2.1, 6.4 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ... |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

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### 6.1.6 Uplink switching

The UE may omit uplink transmission during the uplink switching gap if the conditions defined in this clause are met and the UE is configured with *uplinkTxSwitching* or *uplinkTxSwitchingMoreBands*. The switching gap is indicated by UE capability *uplinkTxSwitchingPeriod2T2T* if *uplinkTxSwitching-2T-Mode* is configured *uplinkTxSwitchingPeriod3TxScenario1* if *uplinkTxSwitchingPeriod3TxScenario1* is configured, and *uplinkTxSwitchingPeriod* otherwise in clauses 6.1.6.1, 6.1.6.2.0, 6.1.6.3, and is determined based on higher layer parameter *switchingPeriodConfigForBandPair* in clause 6.1.6.2.2 for uplink switching configured with 2, 3 or 4 uplink bands if *uplinkTxSwitchingMoreBands* is configured:

- If a UE indicated a capability for uplink switching with *BandCombination-UplinkTxSwitch* for a band combination, and if it is for that band combination

- Configured with a MCG using E-UTRA radio access and with a SCG using NR radio access (EN-DC), or

- Configured with uplink carrier aggregation, or

- Configured in a serving cell with two uplink carriers with higher layer parameter *supplementaryUplink*.

 The conditions under which the switching gap may be present are defined for each of the cases in clauses 6.1.6.1, 6.1.6.2, and 6.1.6.3 respectively.

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(s) triggering the switch given in clause 5.3, clause 5.4, clause 6.1, clause 6.2.1, clause 6.4 and in clause 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, 1, µUL, 2*), where the *µUL, 1* corresponds to the subcarrier spacing of the active UL BWP of one uplink carrier before the switching gap and the *µUL, 2* corresponds to the subcarrier spacing of the active UL BWP of the other uplink carrier after the switching gap.

For uplink switching configured with 3 or 4 uplink bands

- If two contiguous intra-band uplink carriers are configured to a UE, the UE may assume that the active UL BWPs of the two carriers are configured with the same subcarrier spacing.

- The UE does not expect to perform more than one uplink switching in a reference slot with *µUL*, where the *µUL* corresponds to the maximum subcarrier spacing of the active UL BWPs of all the configured uplink carriers.

- If 500 µs is determined by the UE capability *uplinkTxSwitchingMinimumSeparationTime*, when within any two consecutive reference slots corresponding to numerology *µUL*,

- the UE first performs one uplink switch and later performs another uplink switch and

- at least three bands are involved in the transmissions before the first switch, between the first switch and the second switch, and after the second switch,

the separation time between the start of all transmission(s) after the first switch and the start of all transmission(s) after the second switch is not expected to be less than 500 µs. If other than 500 µs is determined by the UE capability *uplinkTxSwitchingMinimumSeparationTime*, no additional restrictions apply.

- If an uplink switching is triggered for uplink transmission(s) with a gap between the start of the first uplink transmission(s) and the end of the last preceding uplink transmission(s) that is smaller than the determined switching gap , the UE determines the band of the switching period location, defined in [8, TS 38.101-1] based on the priority of the bands configured by *uplinkTxSwitchingBandList*. Among the bands either in switch-from or switch-to bands but not both, the switch is located on either,

- the switch-from band(s) if the highest priority band is a switch-to band, or

- the switch-to band(s) if the highest priority band is a switch-from band.

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##### 6.1.6.2.0 Uplink switching with two uplink bands

For a UE indicating a capability for uplink switching with *BandCombination-UplinkTxSwitch,* *uplinkTxSwitchingPeriod2T2T, or uplinkTxSwitchingPeriod3TxScenari1* for a band combination, and if it is for that band combination configured with uplink carrier aggregation:

- If the UE is configured with uplink switching with parameter *uplinkTxSwitching*, when the UE is to transmit in the uplink based on DCI(s) received before or based on a higher layer configuration(s):

- If *uplinkTxSwitchingPeriod3TxScenari1* is not configured,when the UE is to transmit a 2-port transmission on one uplink carrier on one band and if the preceding uplink transmission is a 1-port transmission on another uplink carrier on another band, then the UE is not expected to transmit for the duration of on any of the carriers.

- If *uplinkTxSwitchingPeriod3TxScenari1* is not configured, when the UE is to transmit a 1-port transmission on one uplink carrier on one band and if the preceding uplink transmission is a 2-port transmission on another uplink carrier on another band, then the UE is not expected to transmit for the duration of on any of the carriers.

- For the UE configured with *uplinkTxSwitchingOption* set to 'switchedUL', when the UE is to transmit a 1-port transmission on one uplink carrier on one band and if the preceding uplink transmission was a 1-port transmission on another uplink carrier on another band, then the UE is not expected to transmit for the duration of on any of the carriers.

- For the UE configured with *uplinkTxSwitchingOption* set to 'dualUL', or with *uplinkTxSwitchingPeriod3TxScenari1*, when the UE is to transmit a 2-port transmission on one uplink carrier on one band and if the preceding uplink transmission was a 1-port transmission on a carrier on the same band and the UE is under the operation state in which 2-port transmission cannot be supported in the same band, then the UE is not expected to transmit for the duration of on any of the carriers.

- For the UE configured with *uplinkTxSwitchingOption* set to 'dualUL', when the UE is to transmit a 1-port transmission on one uplink carrier on one band and if the preceding uplink transmission was a 1-port transmission on another uplink carrier on another band and the UE is under the operation state in which 2-port transmission can be supported in the same band, then the UE is not expected to transmit for the duration of on any of the carriers.

- For the UE configured with *uplinkTxSwitchingOption* set to 'dualUL', if the UE is configured with *uplinkTxSwitching-DualUL-TxState* set to 'oneT', when the UE is under the operation state in which 2-port transmission can be supported on one carrier on one band followed by no transmission on any carrier on the same band and 1-port transmission on the other carrier on another band the UE shall consider this as if 1-port transmission was transmitted on both uplinks, otherwise the UE shall consider this as if 2-port transmission took place on the transmitting carrier.

- If *uplinkTxSwitching-2T-Mode* or *uplinkTxSwitchingPeriod3TxScenari1* is configured, when the UE is to transmit a 2-port transmission on one uplink carrier on one band and if the preceding uplink transmission is a 2-port transmission on another uplink carrier on another band, then the UE is not expected to transmit for the duration of on any of the carriers.

- If [*uplinkTxSwitching3TxScenario1*] is configured, when the UE is to transmit a 2-port transmission on one uplink carrier on one band and if the preceding uplink transmission was a 1-port transmission on another uplink carrier on another band and the UE is under the operation state in which 2-port transmission can be supported on the same band, then the UE is not expected to transmit for the duration of on any of the carriers.

- If [*uplinkTxSwitching3TxScenario1*] is not configured, The UE is not expected to be scheduled or configured with uplink transmissions that result in simultaneous transmission on two antenna ports on one uplink carrier on one band, and any transmission on another uplink carrier on another band.

- In all other cases the UE is expected to transmit normally all uplink transmissions without interruptions.

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### 6.2.1 UE sounding procedure

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For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource* is set to 'aperiodic':

- the UE receives a configuration of SRS resource sets,

- the UE receives a downlink DCI, a group common DCI, or an uplink DCI based command where a codepoint of the DCI may trigger one or more SRS resource set(s). For SRS in a resource set with usage set to 'codebook' or 'antennaSwitching', the minimal time interval between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is *N2*  symbols and an additional time duration *Tswitch*. Otherwise, the minimal time interval between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is *N2* +14 symbols and an additional time duration *Tswitch*. The minimal time interval unit of OFDM symbol is counted based on the minimum subcarrier spacing given by min(*µPDCCH, µUL*) where *µUL* is given by min(*µUL,carrier1, µUL,carrier2, µSRS*) when the UE is configured with the higher layer parameter *uplinkTxSwitchingOption* set to 'dualUL' or configured with *uplinkTxSwitching3TxScenario1* for uplink carrier aggregation, and by *µSRS*otherwise. *µSRS* and *µPDCCH*are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively.

- *Tswitch*, *µUL,carrier1* and *µUL,carrier2* are defined in clause 6.4.

- A UE reporting its UE capability 'srs-TriggeringDCI' can be indicated with DCI 0\_1 and 0\_2 to trigger aperiodic SRS without data and without CSI as described in clause 7.3.1.1 of [5, TS 38.212]. Otherwise, except for DCI format 0\_1/0\_2 with CRC scrambled by SP-CSI-RNTI, a UE is not expected to receive a DCI format 0\_1/0\_2 with UL-SCH indicator of "0" and CSI request of all zero(s) as described in clause 7.3.1.1 of [5, TS 38.212].

- If the UE receives the DCI triggering aperiodic SRS in slot *n* and at least one resource set is configured with parameter *availableSlotOffset* across all configured BWPs in a component carrier except when SRS is configured with the higher layer parameter *SRS-PosResource*,

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## 6.4 UE PUSCH preparation procedure time

If the first uplink symbol in the PUSCH allocation for up to two transport blocks, including the DM-RS, as defined by the slot offset *K2* and Koffset, if configured, and the start *S* and length *L* of the PUSCH allocation indicated by '*Time domain resource assignment*' of the scheduling DCI and including the effect of the timing advance, is no earlier than at symbol *L2*, where *L2* is defined as the next uplink symbol with its CP starting  after the end of the reception of the last symbol of the PDCCH carrying the DCI scheduling the PUSCH, then the UE shall transmit the PUSCH. When the PDCCH reception includes two PDCCH candidates from two respective search space sets, as described in clause 10.1 of [6, TS 38.213], for the purpose of determining the last symbol of the PDCCH carrying the DCI scheduling the PUSCH, the PDCCH candidate that ends later in time is used.

*- N2* is based on *µ* of Table 6.4-1 and Table 6.4-2 for UE processing capability 1 and 2 respectively, where *µ* corresponds to the one of (*µDL*, *µUL*) resulting with the largest *Tproc,2*, where the *µDL* corresponds to the subcarrier spacing of the downlink with which the PDCCH carrying the DCI scheduling the PUSCH was transmitted and *µUL* corresponds to the subcarrier spacing of the uplink channel with which the PUSCH is to be transmitted, and *κ* is defined in clause 4.1 of [4, TS 38.211].

*-* For operation with shared spectrum channel access in FR1, is calculated according to [4, TS 38.211], otherwise =0.

- If the first symbol of the PUSCH allocation consists of DM-RS only, then *d2,1* = 0*,* otherwise *d2,1* = 1.

- If the UE is configured with multiple active component carriers, the first uplink symbol in the PUSCH allocation further includes the effect of timing difference between component carriers as given in [11, TS 38.133].

- If the scheduling DCI triggered a switch of BWP, *d2,2* equals to the switching time as defined in [11, TS 38.133], otherwise *d2,2*=0.

- If a PUSCH of a larger priority index would overlap with a PUCCH of a smaller priority index and the PUCCH and PUSCH are not simultaneously transmitted, and the UE is not provided *uci-MuxWithDiffPrio* for theprimary PUCCH group or *uci-MuxWithDiffPrioSecondaryPUCCHgroup* for the secondary PUCCH group, *d2* for the PUSCH of a larger priority is set as reported by the UE; otherwise *d2 = 0.*

- For a UE that supports capability 2 on a given cell, the processing time according to UE processing capability 2 is applied if the high layer parameter *processingType2Enabled* in *PUSCH-ServingCellConfig* is configured for the cell and set to 'enable'.

- If the PUSCH indicated by the DCI is overlapping with one or more PUCCH channels, then the transport block(s) is(are) multiplexed following the procedure in clause 9.2.5 of [6, TS 38.213], otherwise the transport block(s) is(are) transmitted on the PUSCH indicated by the DCI.

- If uplink switching gap is triggered as defined in clause 6.1.6, ** equals to the switching gap duration and for the UE configured with higher layer parameter *uplinkTxSwitchingOption* set to 'dualUL' or configured with *uplinkTxSwitching3TxScenario1* for uplink carrier aggregation *µUL*=min(*µUL,carrier1, µUL,carrier2*), otherwise **.

*- d3* is set as reported by UE if the UE is configured with *sTx-2Panel* and the PUSCH associated with a value of *coresetPoolIndex* is fully/partially overlapping in time domain and is fully/partially/non-overlapping in frequency domain with another PUSCH that is associated with a different value of *coresetPoolIndex* on a same serving cell; otherwise *d3* = 0.

*- d4* is set as reported by UE if the number of transport blocks in the PUSCH is 2; otherwise *d4* = 0.

Otherwise the UE may ignore the scheduling DCI.

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