3GPP TSG RAN WG1 Meeting #100bis R1-200xxxx

e-Meeting, April 20th – 30th, 2020

**Agenda item:** **7.2.10.2**

**Source: Moderator (Apple Inc).**

**Title:** **Summary #1 of email discussions on single Tx transmission in EN-DC**

**Document for:** **Decision**

# Introduction and Proposals

Per chairman’s guidance, I’d like to kick off the email discussion on following issue:

[100b-e-NR- LTE\_NR\_DC\_CA-SingleTx-01] Email discussion/approval regarding the following issues:

* Issue 1 on type 1 UE hailing of colliding UL in single Tx operation, as described in section 2 of [R1-2002348](file:///c:/Users/wanshic/OneDrive%2520-%2520Qualcomm/Documents/Standards/3GPP%2520Standards/Meeting%2520Documents/TSGR1_100b/Docs/R1-2002348.zip)
* Issue 2 on type 1 UE capability with semi-static UL transmission, as described in section 3 of [R1-2002348](file:///c:/Users/wanshic/OneDrive%2520-%2520Qualcomm/Documents/Standards/3GPP%2520Standards/Meeting%2520Documents/TSGR1_100b/Docs/R1-2002348.zip)
  + Discussion of the TP is delayed until the corresponding UE feature discussions finish.
* Issue 3a and 3b on clarification of Type 2 UE behavior, as described in sections 4.1 and 4.2 of [R1-2002348](file:///c:/Users/wanshic/OneDrive%2520-%2520Qualcomm/Documents/Standards/3GPP%2520Standards/Meeting%2520Documents/TSGR1_100b/Docs/R1-2002348.zip), respectively.

till 4/23, with potential TPs for approval till 4/28 – (Apple, Wei)

# Type 1 UE handling of colliding UL in 1Tx operation

**Background**: It was discussed in RAN1 #100e that the current description in 38.213 does not capture type 1 UE behavior for ‘single-tx’ case, as the corresponding text is under the condition “*If a UE is configured with …*”. For single-tx case, the UE cannot transmit simultaneously on LTE and NR regardless of *, * settings. So, the behavior of dropping NR should be specified outside the ** restriction.

This issue was brought up and discussed in RAN1 #100e, and two alternative TP’s were proposed. However no consensus was reached. For this meeting, a 3rd TP was also proposed by Qualcomm [6]. These 3 proposed TP are listed below:

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| **TP option 1**  ---------------------------- start TP1 to sub clause 7.6.1 of 38.213v16.1.0 --------------------------------------  7.6.1 EN-DC  If a UE is configured with a MCG using E-UTRA radio access and with a SCG using NR radio access, the UE is configured a maximum power  for transmissions on the MCG by *p-MaxEUTRA* and a maximum power  for transmissions in FR1 on the SCG by *p-NR-FR1*.  The UE determines a transmission power for the MCG as described in [13, TS 36.213] using  as the maximum transmission power. The UE determines transmission power for the SCG in FR1 as described Clauses 7.1 through 7.5 using  as the maximum transmission power. The UE determines transmission power for the SCG in FR2 as described Clauses 7.1 through 7.5.  A UE does not expect to be configured for operation with shortened TTI and/or processing time [13, TS 36.213] on a cell that is included in an EN-DC configuration.  If the UE indicates capability for dynamic power sharing between E-UTRA and NR for EN-DC, and if the UE is configured with *tdm-PatternConfig-r16*, then for the band combinations for which the UE indicates using *singleUL-Transmission* that it does not support simultaneous  UL transmissions (as defined in TS 38.101-3 [8-3]), the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.  If a UE is configured with , where  is the linear value of ,  is the linear value of , and  is the linear value of a configured maximum transmission power for EN-DC operation as defined in [8-3, TS 38.101-3] for FR1, the UE determines a transmission power for the SCG as follows.  - If the UE is configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r15* or by *tdm-PatternConfig-r16* in [13, TS 36.213])  - If the UE does not indicate a capability for dynamic power sharing between E-UTRA and NR for EN-DC, the UE does not transmit in a slot on the SCG in FR1 when a corresponding subframe on the MCG is an UL subframe in the reference TDD configuration.  - ~~If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, and does not indicate a capability~~ *~~tdm-Pattern-dualTx~~* ~~in [16, TS 38.306], and is configured with~~ *~~tdm-PatternConfig-r16~~*~~, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.~~  - If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC and  - if UE transmission(s) in subframe  of the MCG overlap in time with UE transmission(s) in slot  of the SCG in FR1, and |

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| **TP option 2**  ---------------------------- start TP2 to sub clause 7.6.1 of 38.213v16.1.0 --------------------------------------  7.6.1 EN-DC  If a UE is configured with a MCG using E-UTRA radio access and with a SCG using NR radio access, the UE is configured a maximum power  for transmissions on the MCG by *p-MaxEUTRA* and a maximum power  for transmissions in FR1 on the SCG by *p-NR-FR1*.  The UE determines a transmission power for the MCG as described in [13, TS 36.213] using  as the maximum transmission power. The UE determines transmission power for the SCG in FR1 as described Clauses 7.1 through 7.5 using  as the maximum transmission power. The UE determines transmission power for the SCG in FR2 as described Clauses 7.1 through 7.5.  A UE does not expect to be configured for operation with shortened TTI and/or processing time [13, TS 36.213] on a cell that is included in an EN-DC configuration.  If the UE indicates capability for dynamic power sharing between E-UTRA and NR for EN-DC and does not indicate a capability tdm-Pattern-dualTx in [16, TS 38.306], and is configured with *tdm-PatternConfig-r16*, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.  If a UE is configured with , where  is the linear value of ,  is the linear value of , and  is the linear value of a configured maximum transmission power for EN-DC operation as defined in [8-3, TS 38.101-3] for FR1, the UE determines a transmission power for the SCG as follows.  - If the UE is configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r15* or by *tdm-PatternConfig-r16* in [13, TS 36.213])  - If the UE does not indicate a capability for dynamic power sharing between E-UTRA and NR for EN-DC, the UE does not transmit in a slot on the SCG in FR1 when a corresponding subframe on the MCG is an UL subframe in the reference TDD configuration.  - ~~If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, and does not indicate a capability~~ *~~tdm-Pattern-dualTx~~* ~~in [16, TS 38.306], and is configured with~~ *~~tdm-PatternConfig-r16~~*~~, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.~~  - If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC and  - if UE transmission(s) in subframe  of the MCG overlap in time with UE transmission(s) in slot  of the SCG in FR1, and |

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| **TP option 3**  ---------------------------- start TP3 to sub clause 7.6.1 of 38.213v16.1.0 --------------------------------------  If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, for the band combinations for which the UE indicates *singleUL-Transmission*, if the conditions in TS 38.101-3 [8-3] are fullfilled,  - If the UE is configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r16* in [13, TS 36.213]),  - the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on an UL-offset subframe (as specified in [13, TS 36.213]) on the MCG  - the UE does not expect to be configured or indicated to transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe other than the UL-offset subframes (as specified in [13, TS 36.213]) on the MCG  - Otherwise,  - the UE does not expect to be configured or indicated to transmit on the SCG in FR1 when the UE has overlapped transmission on any subframe on the MCG.  If a UE is configured with , where  is the linear value of ,  is the linear value of , and  is the linear value of a configured maximum transmission power for EN-DC operation as defined in [8-3, TS 38.101-3] for FR1, the UE determines a transmission power for the SCG as follows.  - If the UE is configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r15* or by *tdm-PatternConfig-r16* in [13, TS 36.213])  - If the UE does not indicate a capability for dynamic power sharing between E-UTRA and NR for EN-DC, the UE does not transmit in a slot on the SCG in FR1 when a corresponding subframe on the MCG is an UL subframe in the reference TDD configuration.  ~~- If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, and does not indicate a capability~~ *~~tdm-Pattern-dualTx~~* ~~in [16, TS 38.306], and is configured with~~ *~~tdm-PatternConfig-r16~~*~~, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.~~  - If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC and  - if UE transmission(s) in subframe  of the MCG overlap in time with UE transmission(s) in slot  of the SCG in FR1, and  - if  in any portion of slot  of the SCG,  the UE reduces transmission power in any portion of slot  of the SCG so that  in any portion of slot , where  and  are the linear values of the total UE transmission powers in subframe  of the MCG and in slot  of the SCG in FR1, respectively. The UE is not required to transmit in any portion of slot  of the SCG if  would need to be reduced by more than the value provided by *XSCALE* in order for  in any portion of slot  of the SCG. The UE is required to transmit in slot  of the SCG if  would not need to be reduced by more than the value provided by *XSCALE* in order for  in all portions of slot .  - If the UE does not indicate a capability for dynamic power sharing between E-UTRA and NR for EN-DC, the UE expects to be configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r15* or by *tdm-PatternConfig-r16* in [13, TS 36.213]). |

I’d like companies to provide input to the following questions:

* **Q1-1: In addition to the following cases, is there any other case where network can configure a UE can be configured with case 1 Reference HARQ timing (i.e. tdm-PatternConfig-r16)? (If yes, please also point us to the RAN1 agreement)**
  + **Case 1): type 1 UE indicates singleUL-Transmission for the difficult BC listed in 38.101**
  + **Case 2): type 1 UE indicates tdm-pattern-dualTx for BC with potential DL de-sense due to harmonics**
  + **Case 3): type 2 UE configured with P\_lte + P\_nr > P\_total**

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| Company | Comments |
| ZTE | We feel like the current spec doesn’t preclude configuring tdm-PatternConfig for other cases in addition to the above three cases. The key issue is, for a UE indicates neither singleUL-Transmission or tdm-pattern-dualTx, it is not clear whether it should be regarded as a “single Tx” UE or a “dual Tx” UE.  ***tdm-Pattern***  Indicates whether the UE supports the *tdm-PatternConfig* for *single UL-transmission* associated functionality, as specified in TS 36.331 [17]. Support is conditionally mandatory in (NG)EN-DC for UEs that do not support dynamicPowerSharingENDC and for UEs that indicate single UL transmission for any (NG)EN-DC BC. Support is conditionally mandatory in NE-DC for UEs that do not support dynamicPowerSharingNEDC and for UEs that indicate single UL transmission for any NE-DC BC. The feature is optional otherwise. |
| Apple | For type 1 UE, supporting TDM pattern is optional feature, so only after UE indicated singleUL-Transimssion or tdm-pattern-dual Tx, then gNB can configured t *tdm-PatternConfig-16.*  For type 2 UE, supporting TDM pattern is mandatory feature, so network can configure the *tdm-PatternConfig/ tdm-PatternConfig-16* without UE reporting capability. And for the case of P\_LTE + P\_NR <= Pcmax, the network can configure the TMD pattern as well, this was agreed in RAN1#91 meeting, but it was not captured in the spec.   * + Operation B with Case1: P\_LTE + P\_NR <= Pcmax, in which case NR UL can be scheduled in any UL subframe/slot (while the UE behaviour in case of being simultaneously scheduled on LTE and NR uplinks is not specified)   As the issue#1 is only related to type1 UE, so network can only configure UE with TMD pattern for case 1 and case 2. |
| MTK | As quoted by ZTE about the definition of ***tdm-Pattern***, it is mandatory for Type 2 UE and single UL UE, and still can be configured for other scenarios. It seems to us the current spec does not preclude configuring **tdm-PatternConfig-r16** to UE for other cases in addition to the three cases mentioned in Q1-1. We also think whether the network can configure **tdm-PatternConfig-r16** is not related to Type1/Type2 UE or P\_lte + P\_nr > P\_total. The expected UE behavior in our opinion is listed as below: |
| Huawei, HiSilicon | As MediaTek pointed out, there are three UE capabilities in Rel-16, and the first one singleUL-Transmission is for IMD issue, a UE reporting support of tdm-pattern can be a UE without IMD issue and capable of dynamic power sharing, which is proved by the sentence “The feature is optional otherwise.” in 38.306 highlighted by ZTE. Therefore, the current UE behaviors for three capabilities are as the table below,   |  |  |  | | --- | --- | --- | | **UE capability :  RRC configuration** | **tdm-PatternConfig-r16 configured** | **tdm-PatternConfig-r16 NOT configured** | | tdm-pattern | Single UL Tx | N/A | | tdm-pattern-dual-Tx | Dual UL Tx | N/A | | singleUL-Transmission | Single UL Tx | Single UL Tx |   Regarding ZTE’s question whether the UE is regarded as “dual Tx” or “single Tx”, it has been answered by the first agreement below, i.e. **the reason to introduce tdm-pattern-dual-Tx was, as the highlight in the table above, tdm-pattern only indicates Single UL Tx under Rel-16 TDM pattern configuration, but no restriction if TDM pattern is not configured.** **If tdm-pattern were indicating Dual UL Tx in Rel-16, we would not have introduced a new UE capability tdm-pattern-Dual-Tx**.  Please note that the two agreements following the agreement of dual-Tx capability was to discuss the UE behavior for a UE configured with TDM pattern, instead of a UE suffering IMD issue or not. Under a TDM pattern configuration, the dual-Tx case refers to a UE capable of the new tdm-pattern-dual-Tx instead of a UE not reporting IMD issue. Similarly, the single-Tx case is not bound to IMD issue.  In short, only Option 2 is in line with the agreements.  Agreements:   * Introduce a new UE capability of supporting DL reference configuration for dual-Tx UL (e.g., to handle DL de-sensing from harmonics)   Agreements:   * For the single-Tx case, for FDD LTE Pcell,   + All uplink subframes can be scheduled for LTE for type 1 UEs     - In which case, NR transmission is dropped for when the LTE and NR transmissions collide     - Note: there is no change of UL scheduling timing for LTE   Agreements:   * For the dual-Tx case, for FDD LTE Pcell,   + All uplink subframes can be scheduled for LTE at least for type 1 UEs   + Note: there is no change of UL scheduling timing for LTE |
| Qualcomm | Case 1) should be “type 1 UE indicates *singleUL-Transmission* for the difficult BC listed in 38.101-3 and the condition of single-UL allowed described in Annex I of 38.101-3 is satisfied”.  Let us clarify why we propose TP option 3. There are three different points.  **1) The condition where single-UL is allowed**  The condition where single-UL is allowed is specified in RAN4 spec; even for a band combination where the UE reports *singleUL-Transmission*, single-UL is not always allowed. Since the text proposals will define the UE behavior of single-UL transmission, the text shall refer the RAN4’s condition where the single-UL transmission is allowed. Therefore, Option 3 has the text “*if the conditions in TS 38.101-3 [8-3] are fullfilled*”. Without this clarification, the case where the single-UL is allowed is expanded compared to Rel.15, which should not be the case. Corresponding RAN4 spec is copied below from TS38.101-3 for the convenience. Companies should check with RAN4 colleagues.  Annex I (normative): Dual uplink interferer  UE is mandated to support operation in dual and triple uplink mode for EN-DC configuration in NR FR1 listed in Table 5.5B.2-1, Table 5.5B.3-1, and Table 5.5B.4.1-1 and indicated by column single uplink allowed, Table 7.3B.2.3.5.1-1, Table 7.3B.2.3.5.2-0, Table 7.3B.2.3.5.2-1 or NE-DC configuration in NR FR1 listed in Table 5.5B.4a.1-1 and indicated by column single uplink allowed if the intermodulation products caused by the dual uplink operation do not interfere with its own primary downlink transmission channel bandwidth of PCell or PSCell. For intermodulation products falling into any secondary downlink channel bandwidth, UE single UL capability is not considered.  **2) Handling LTE + NR collision if the UE is not configured with *tdm-PatternConfig-r16***  There is no spec on how the UE should do if the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC and the UE needs single-Tx operation, but the UE is not configured with *tdm-PatternConfig-r16*. In this is not configured, the UE behaviour should follow the Rel.15 behavior: i.e., “The UE behaviour in case of being simultaneously scheduled on LTE and NR uplinks is not specified” as per RAN1#90b agreement. This is why Option 3 has the text below:  - Otherwise,  - the UE does not expect to be configured or indicated to transmit on the SCG in FR1 when the UE has overlapped transmission on any subframe on the MCG.  **3) Handling LTE + NR collision if the UE is configured with *tdm-PatternConfig-r16***  We prefer to define the UE behaviour as following: (1) the UE drops NR UL if it collides with LTE UL in the offset-UL subframes, and (2) the UE does not expect collision of NR UL with LTE UL in a subframe other than offset-UL subframes. The reason behind this is following.  We propose following formulation for UE features:  Case 1: EN-DC single-Tx with TDD-PCell  For EN-DC single-Tx with TDD-PCell, we propose to define FG18-2 such that it supports EN-DC single-Tx operation using *tdm-PatternConfig-r16* but all LTE UL transmissions are confined within the offset-UL subframes, and FG18-3a such that it additionally supports LTE UL transmissions on subframes other than offset-UL subframes on top of FG18-2. Then for NR UL transmissions, the UE behaviour is consistent between FG18-2 and FG18-3a; the UE drops NR UL if it collides with LTE UL in a offset-UL subframes, and the UE does not expect NR UL if it collides with LTE UL in a subframe other than offset-UL subframes.  Case 2: EN-DC single-Tx with FDD-PCell  For EN-DC single-Tx with FDD-PCell, there has been a FG6-13 that supports EN-DC single-Tx operation using *tdm-PatternConfig-r15* but all LTE UL transmissions are confined within the offset-UL subframes. FG18-2a can work same as FG18-3a to FG18-2, i.e., if the UE supports FG18-3a, then the UE is able to transmit LTE UL on a subframe other than offset-UL subframes.  If the clarifications of FGs as above are achieved, then there are two categories of UEs: one UE category can transmit LTE UL only within offset-UL subframes, and the other UE category can transmit LTE UL any UL subframes. The proposal “(1) the UE drops NR UL if it collides with LTE UL in the offset-UL subframes, and (2) the UE does not expect collision of NR UL with LTE UL in a subframe other than offset-UL subframes” does requires UE the common behaviour for NR side. This is why Option 3 has the text below:  If the UE is configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r16* in [13, TS 36.213]),  - the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on an UL-offset subframe (as specified in [13, TS 36.213]) on the MCG  - the UE does not expect to be configured or indicated to transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe other than the UL-offset subframes (as specified in [13, TS 36.213]) on the MCG |
| Ericsson | NW has to know whether UE supports corresponding behavior before it can configure the parameter for the UE. This is determined by capability signaling. Specifically   * For *tdm-PatternConfig-r15* 🡪 NW knows via *tdm-Pattern* UE capability indication * For *tdm-PatternConfig-r16* 🡪 UE capabilities are still being discussed |
| Samsung | Yes. There are other cases where network can configure a UE with *tdm-PatternConfig-r16* which can be justified by the wording “the feature is optional otherwise” in *tdm-Pattern* highlighted by ZTE. |
| Nokia | Agree with ZTE. |
| Intel | Yes, other combinations of the parameters are possible. |
| Apple 2 | I’m not sure ZTE’s understanding is aligned with the RAN2 spec.  The confusion part is the wording of “the feature is optional otherwise” in UE capability of ***tdm-Pattern***. To me, this wording points to type 1 UE without IMD issue but supporting the TDM pattern. This type of UE can be configured with *tdm-PatternConfig.* Checking further the IE *tdm-PatternConfig* defined in 36.331 as showing below, this IE is used when power control or IMD issues **required single UL transmission**. So it’s very clear that if the *tdm-PatternConfig* is configured to UE (whatever it is type 2 UE, or type 1 UE with/without IMD issue), only single UL transmission is allowed, no other usage scenarios is specified in the spec.  In short, we only defined the single UL transmission in Rel.15. Now in Rel.16, we introduce the dual Tx transmission. So, UE will only report either single UL transmission capability (*singleUL-Transmission*  , and/or *tdm-Pattern* (including the type 1 UE no IMD issues)) or dual transmission capability (tdm-pattern-dualTx). No other case the network can configure the *tdm-PatternConfig-r16*.  ***tdm-Pattern***  Indicates whether the UE supports the *tdm-PatternConfig* for *single UL-transmission* associated functionality, as specified in TS 36.331 [17]. Support is conditionally mandatory in (NG)EN-DC for UEs that do not support dynamicPowerSharingENDC and for UEs that indicate single UL transmission for any (NG)EN-DC BC. Support is conditionally mandatory in NE-DC for UEs that do not support dynamicPowerSharingNEDC and for UEs that indicate single UL transmission for any NE-DC BC. The feature is optional otherwise.  ***tdm-PatternConfig***  UL/DL reference configuration indicating the time during which a UE configured with (NG)EN-DC is allowed to transmit. This field is used when power control or IMD issues require single UL transmission as specified in TS 38.101-3 [101] and TS 38.213 [88]. |

* **Q1-2: Which of the 3 proposed TPs are acceptable**

Below are companies’ feedback:

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| Company | Comments |
| ZTE | We prefer Option1.  For a UE indicates neither singleUL-Transmission or tdm-pattern-dualTx, our understanding is that this UE should be regarded as a “dual Tx” UE.  Seems like two issues are mixed up in Option3. We prefer to separate the discussion of “not expect to be configured or indicated to transmit”. |
| Apple | TP1 is preferred. It’s clearer and no confusion. |
| MTK | To our understanding, “UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG (LTE)” only holds when **UE indicates singleUL-Transmission**. Hence, we prefer Option 1 or Option 3. |
| Huawei, HiSilicon | Only Option 2 is in line with agreements. |
| Qualcomm | Option 3. |
| Ericsson | We support Option 1.  As explained in detail in our contribution, adopting Option 1 has no impact on the agreement on UE capability of supporting DL reference configuration for dual-Tx UL.  Option 3 (i.e., the restrictions related to ‘UL’ subframes given by reference TDD pattern) is not the agreed behavior.  *Agreements:*   * *For the single-Tx case, for FDD LTE Pcell,*   + *All uplink subframes can be scheduled for LTE for type 1 UEs*     - *In which case, NR transmission is dropped for when the LTE and NR transmissions collide*     - *Note: there is no change of UL scheduling timing for LTE*   *Agreements:*   * *For the single-Tx case, for TDD LTE Pcell,*   + *All uplink subframes can be scheduled for LTE for type 1 UEs*     - *In which case, NR transmission is dropped for when the LTE and NR transmissions collide* |
| Samsung | Given the discussion so far, option 1 is preferred. |
| Nokia | Option 1. Notably option 3 is redefining the Rel-15 behaviour and would be very difficult to do for Rel-16. |
| Intel | Option 1 is preferred |

* **Q1-3: Do we agree with the description of UE behavior in column “type 1 UE behavior if configured tdm-PatternConfig” in the table below**:

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| index | SingleUL-Transmission | tdm-pattern | tdm-pattern-dualTx | type 1 UE behavior if configured tdm-PatternConfig-r16 | comments |
| 1 | 1 | 1 | 1 | Invalid | UE should not indicate tdm-pattern  and tdm-pattern-dualTx at the same time |
| 2 | 1 | 1 | 0 | Single UL |  |
| 3 | 1 | 0 | 1 | Invalid | According to 38.306, for UE indicate singleUL-transmission for any BC, UE is mandated to support case1 HARQ timing |
| 4 | 1 | 0 | 0 | Invalid | According to 38.306, for UE indicate singleUL-transmission for any BC, UE is mandated to support case1 HARQ timing |
| 5 | 0 | 1 | 1 | Invalid | UE should not indicate tdm-pattern  and tdm-pattern-dualTx at the same time |
| 6 | 0 | 1 | 0 | single UL | UE not capable of case 1 HARQ timing with dual Tx |
| 7 | 0 | 0 | 1 | dual Tx |  |
| 8 | 0 | 0 | 0 | Invalid | UE not capable of case 1 HARQ timing |

Below are companies’ feedback:

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| Company | Comments |
| ZTE | Row 6 is a valid scenario |
| Qualcomm | Row 6 should not be supported |
| Huawei | Row 6 is already supported |

***Feature lead summary:***

Summary of Q1-1: Companies have the following understanding:

* Network has the flexibility (i.e., current spec does not preclude the network) to configure a UE with case 1 Reference HARQ timing (i.e. tdm-PatternConfig-r16) in scenarios other than the 3 cases listed in Q1-1
  + ZTE, MTK, HW, Samsung, Nokia, Intel
* Only the 3 cases listed in Q1-1 are possible
  + Apple

Summary of Q1-2:

* TP option 1: ZTE, Apple, MTK, Ericsson, Samsung, Nokia, Intel
* TP option 2: HW
* TP option 3: QC, MTK

Summary of Q1-3:

* Row 6 is supported: ZTE, Huawei
* Row 6 is not suppored:

If the table is correct, then both TP option 1 and TP option 2 are technically correct, except that TP option 2 also covers row #6. Then I guess the question is whether everyone believe that row 6 is indeed a valid scenario.

If there is no consensus that row #6 (in the table from Q1-3) should be supported, then adopt TP option 1. This is because there is a clear majority of companies support TP option 1 and it also matches with existing RAN1 agreement. In addition, it also address QC’s concern on referencing the RAN4 spec.

However, if the consensus is row #6 is valid, then we might want to adopt TP option #2 (at least in principle), as it also help to clarify UE behavior in more scenarios. Therefore, I would recommend the following:

***FL Proposal:***

* If there is no consensus that row #6 should be supported: then adopt TP option 1.
* If there is consensus that row #6 is valid: then adopt TP option 2.

# Type 1 UE capability with semi-static UL transmission

In RAN1#99, the following agreements were reached [7]. According to the agreement, whether the semi-static configured UL transmissions are allowed in all UL subframes is subjected to UE capability. Two text proposals are provided by [2] [6].

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| Agreements:  For a UE configured with DL-reference DL/UL configuration in Rel-16 (including single Tx with LTE TDD PCell or LTE FDD PCell, and dual Tx cases):   * For type 2 UE (i.e., UE without dynamic power sharing capability), any LTE UL transmissions should take place only in UL subframes designated for HARQ-ACK feedback. * For type 1 UE (i.e., UE with dynamic power sharing capability),   + Confirm that any LTE UL transmissions scheduled/triggered by DCI can take place in UL subframes not designated for HARQ-ACK feedback.   + FFS UE is not expected to transmit semi-statically configured LTE UL transmissions in the UL subframes other than those designated as UL in the DL-reference configuration if such transmission collide with NR UL transmissions.   Agreements  For the FFS part in the agreement above,   * semi-statically configured LTE UL transmissions are allowed in all UL subframes.   + Note: In case of collision, LTE transmission is prioritized   + Note: this configuration is subject to UE capability |

**Proposal 2: Discussion further the detailed TP.**

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| ---------------------------- start ZTE TP to sub clause 7.6.1 of 38.213v16.1.0 --------------------------------------  If a UE is configured with , where  is the linear value of ,  is the linear value of , and  is the linear value of a configured maximum transmission power for EN-DC operation as defined in [8-3, TS 38.101-3] for FR1, the UE determines a transmission power for the SCG as follows.  - If the UE is configured with reference TDD configuration for E-UTRA (by *tdm-PatternConfig-r15* or by *tdm-PatternConfig-r16* in [13, TS 36.213])  - If the UE does not indicate a capability for dynamic power sharing between E-UTRA and NR for EN-DC, the UE does not transmit in a slot on the SCG in FR1 when a corresponding subframe on the MCG is an UL subframe in the reference TDD configuration.  - If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, and does not indicate a capability *tdm-Pattern-dualTx* in [16, TS 38.306], and is configured with *tdm-PatternConfig-r16*, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG.  - If the UE indicates a capability for dynamic power sharing between E-UTRA and NR for EN-DC, and indicates a capability tdm-Pattern-dualTx and a capability semi-staticULTransInAllSubframe in [16, TS 38.306], and is configured with tdm-PatternConfig-r16, the UE does not transmit on the SCG in FR1 when the UE has overlapped transmission that is not associated with a DCI on a subframe on the MCG. |  |

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| ---------------------------- start ZTE TP to sub clause 5.1 of 36.213v16.1.0 --------------------------------------  For a UE configured with EN-DC, if the UE does not indicate a capability for dynamic power sharing (as specified in [17]) and if the UE is configured with *subframeAssignment-r16* for a serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r16* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r16*.  For a UE configured with EN-DC, if the UE indicates a capability for dynamic power sharing and does not indicate a capability *semi-staticULTransInAllSubframe* (as specified in [17]) and if the UE is configured with *subframeAssignment-r16* for a serving cell, the UE is not expected to transmit any uplink physical channel or signal without associated DCI in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r16* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r16*. |

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| ---------------------------- start Qualcomm TP to clause 6 or 8 of 36.213v16.1.0 --------------------------------------  For a UE configured with EN-DC/NE-DC and serving cell frame structure type 1, if the UE is configured with *subframeAssignment-r15* for the serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r15* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r15*.  For a UE configured with EN-DC, if the UE does not indicate a capability for dynamic power sharing (as specified in [17]) and if the UE is configured with *subframeAssignment-r16* for the serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r16* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r16*.  For a UE configured with EN-DC, if the UE indicates a capability for dynamic power sharing (as specified in [17]) and if the UE is configured with *subframeAssignment-r16* for the serving cell, the UE is not expected to be configured or indicated to transmit any uplink physical channel or signal, in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r16* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r16*, if the UE does not indicate the UE capability *[FG18-2a or FG18-3a]* (as specified in [17]). |

As the exact definition of the corresponding UE capability will be discussed in this meeting, and there are different proposals, it might be desirable to wait until the corresponding UE feature discussed is concluded.

***FL proposal 2****: The related TP discussion could be delayed until the corresponding UE feature discussion is completed.*

# Clarifications on Type 2 UE behavior

## Clarification on Type 2 UE behavior

Background: The type 2 UE behavior is not fully specified in the specification TS38.213 for the case of P\_LTE+P\_NR <= P\_total. Specifically, the following proposal on clarification of type 2 UE behavior is made in [3] as follows:

Proposal : Clarify the whether the following UE behaviour is matching the Rel-16 agreement for UL collision handling:

* For Type 2 UE, NR UL can collide with LTE UL under “P\_LTE+P\_NR <= P\_total” and the corresponding transmission behavior is up to UE implementation
* since all slots can be scheduled for NR UL (no restriction) when tdm-PatternConfig-r15 or *tdm-PatternConfig-r15* is configured according to current spec of 38.213 Rel-16 spec 7.6.1 EN-DC.

FL summary: In general, type 2 UE (i.e., without fast communication between LTE and NR modems) has been quite clear from existing agreements:

- LTE UL is only transmitted

- Colliding UL Tx is considered as error case, and it is up to UE implementation.

However, it seems that existing 38.213 does not explicitly capture this for type 2 UE in the case of P\_LTE+P\_NR <= P\_total.

* **Q3-1: Do we need a TP to explicitly clarify in 38.213 type 2 UE assumption/behavior when P\_lte + P\_nr <= P\_total and the UE is configured with Reference HARQ timing? (e.g. up to UE implementation)**

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| Company | Comments |
| ZTE | Our view is that we may first discuss what’s the intended UE behavior in case of P\_lte + P\_nr <= P\_total for type2 UE. And then we could discuss whether a TP is needed or not.  Our preliminary understanding is the UE behavior in case of P\_lte + P\_nr <= P\_total for type2 UE could be the same as that in case of P\_lte + P\_nr > P\_total. We are open to further discuss the intended UE behavior. |
| Apple | Copy/paste our above comments.  And for the case of P\_LTE + P\_NR <= Pcmax, the network can configure the TMD pattern as well, this was agreed in RAN1#91 meeting, but it was not captured in the spec.   * + Operation B with Case1: P\_LTE + P\_NR <= Pcmax, in which case NR UL can be scheduled in any UL subframe/slot (while the UE behaviour in case of being simultaneously scheduled on LTE and NR uplinks is not specified)   We are open to clarify this in the spec. |
| MTK | We agree with FL’s summary that for type 2 UE in the case of P\_LTE+P\_NR <= P\_total,  - LTE UL is only transmitted in designated UL subframes in *tdm-pattern*  - Colliding UL Tx is considered as error case, and it is up to UE implementation.  Constructing a TP to clarify these behaviors seems like a good idea. |
| Huawei, HiSilicon | The target case has been covered by the TP Option2 in issue#1. If it is agreed, no additional text change is needed. |
| Ericsson | We don’t see the need for additional spec text. The Rel15 agreement is clear that behavior is “*not specified”* and specs are aligned with that. |
| Samsung | No need to capture a TP because it is up to UE implementation. |
| Nokia | No need to start working on a Rel-15 clarification. |
| Intel | We agree with FL proposal and think it is really beneficial to have same understandings. We are open if such error case is to be captured. |

***FL Summary***

Based on feedbacks to Q3-1

* TP not needed: Ericsson, Samsung, Nokia, Huawei
* TP needed: Apple, MTK, Intel

As there is no consensus that a TP is needed, we will not further pursue. However, in order to address concern from MTK (and potentially others), maybe it is still helpful that we could draw a conclusion to clarify/reflect our understanding.

***FL proposal: we agreed on the following conclusion (without specification impact):***

*For a type 2 UE configured with P\_LTE+P\_NR <= P\_total, if the UE is configured with tdm-PatternConfig-r16 or tdm-PatternConfig-r15, then for the band combinations for which the UE indicates using singleUL-Transmission that it does not support simultaneous  UL transmissions, the UE behavior is not specified if LTE UL transmission collide with NR UL transmission*.

## Type 2 UE’s assumption on “other than offset-UL subframes”

In Rel.15, the following agreements made in RAN1#90bis.

Agreements:

* In Case 1, LTE TDD UL HARQ timing is supported and the UE is allowed to transmit only in the subframes designated as UL in the reference TDD configuration. Additionally, a UE-specific HARQ subframe offset can be configured.

The agreement was captured in three places, i.e., section 5.1, section 6 and section 8 of TS36.213, with the same contents.

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| For a UE configured with EN-DC/NE-DC and serving cell frame structure type 1, if the UE is configured with *subframeAssignment-r15* for the serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r15* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r15*. |

In Rel. 16, the similar agreements were reached in EN-DC enhancement, as shown below. The agreements were captured in both section 6 and section 8 of TS36.213, but not in section 5.1. To avoid confusion between Rel.15 and Rel.16, It was proposed to capture the same contents in section 5.1 as these in section 6 and section 8 by [4]. But according to [1], this alignment is not necessary.

Agreements:

For a UE configured with DL-reference DL/UL configuration in Rel-16 (including single Tx with LTE TDD PCell or LTE FDD PCell, and dual Tx cases):

* For type 2 UE (i.e., UE without dynamic power sharing capability), any LTE UL transmissions should take place only in UL subframes designated for HARQ-ACK feedback.

**Proposal 3: Discuss further whether adopt the proposed text proposal on uplink power control section in TS36.213.**

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| 5.1 Uplink power control < Unchanged parts are omitted > For a UE configured with EN-DC/NE-DC and serving cell frame structure type 1, if the UE is configured with *subframeAssignment-r15* for the serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r15* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r15*.  For a UE configured with EN-DC, if the UE does not indicate a capability for dynamic power sharing (as specified in [17]) and if the UE is configured with *subframeAssignment-r16* for the serving cell, the UE is not expected to transmit any uplink physical channel or signal in the serving cell on subframes other than offset-UL subframes, where the offset-UL subframes are determined by applying an offset value given by *harq-Offset-r16* to the subframes denoted as uplink in the UL/DL configuration *subframeAssignment-r16*. |

* **Q3-2: Do we need to copy the same text on R16 UE behavior from section 6 & 8 to section 5.1 as well in 36.213? (Note that we indeed have the same text in section 6 & 8 & 5.1 on R15 UE behavior)**

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| Company | Comments |
| ZTE | Copying the same text seems fine to us. |
| Apple | We prefer to capture the TP in the spec, otherwise it could cause confusion why it is different from Rel.15. |
| MTK | We think it is better to copy the same text to section 5.1. |
| Huawei, HiSilicon | It is not necessary. Because such UE behavior has been captured at multiple sections for all PHY UL channels, the specification 36.213 is clear, no need to duplicate them into the section of power control. Or please clarify which PHY UL channel is missing. |
| Qualcomm | As we propose in R1-2002524 and R1-2002559, “the UE is not expected to transmit” should be corrected to “the UE is not expected to be configured or indicated to transmit” overall. According to R1-2001391, for semi-static LTE UL transmission, following description by ZTE was a common understanding among many companies. This implies that at least for semi-static LTE UL transmission, the NW will take care of it. Just copy and paste means that we will carry over the ambiguity from Rel.15 to Rel.16.  Our understanding is as below.   1. The semi-statically configured LTE UL transmissions include periodic SR, configured grant, periodic SRS. 2. If a UE indicates support of semi-static-for-all-subframes, network can configure the semi-static LTE UL transmissions in all UL subframes (i.e., not restricted by the TDM U subframes). Of course, network can also configure the semi-static LTE UL transmissions only in the TDM U subframes. 3. If a UE does NOT indicate support of semi-static-for-all-subframes, network has to configure the semi-static LTE UL transmissions only in the TDM U subframes. |
| Ericsson | No strong view but OK to match Rel15 formulation. |
| Samsung | OK with capturing the TP in the spec. |
| Nokia | OK with the TP. We do not agree with Qualcomm’s correction, which is actually a modification of a feature. UE is not expected to transmit has a clearly different meaning frm UE is not expected to be configured or scheduled to transmit. The Rel-15 definition was not accidential and should not be changed to something else. |
| Intel | No strong view but OK to match Rel15 formulation. |

***Feature lead Summary: based on feedback so far***

* TP not necessary: HW
* OK with the TP: ZTE, Apple, MTK, Ericsson, Samsung, Nokia, Intel

There seems to be a majority view with adopting the TP. So I would recommend the following:

***FL proposal:*** *adopted the proposed TP as in section 4.2.*

# References

1. R1-2001529, “Enhancements for single UL operation for EN-DC”, Huawei, HiSilicon, 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
2. R1-2001619, “Remaining Issues on Single Tx Switched Uplink Solution for EN-DC”, ZTE, 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
3. R1-2001835, “Remaining issues on single Tx switched UL solution for EN-DC”, MediaTek Inc., 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
4. R1-2002347, “Remaining issues on single Tx operation for EN-DC”, Apple, 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
5. R1-2002419, “Remaining issues for single Tx UL enhancements”, Ericsson, 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
6. R1-2002559, “Remaining issues for EN-DC Single-Tx TDM Operation”, Qualcomm Incorporated, 3GPP RAN1#100 bis e-meeting, April 20th – 30th, 2020
7. “Chairman Notes, RAN1 #99”, 3GPP RAN1 #99, Reno, USA, November 18th – 22nd, 2019.