3GPP TSG RAN WG1 Meeting #100bis R1-2004239

e-Meeting, April 20th – 30th, 2020

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

**Source: Moderator (Apple)**

**Title: Feature lead summary on single Tx operation for EN-DC**

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

# Introduction and Proposals

In this document, we summarizes the issues related to R16 single Tx enhancements as discussed in [1]~[5]:

# Issues related to Type 2 UE in Rel.16

Multiple remaining issues were brought up in [3][4][5], related to support of type 2 UE in R16 as well as clarification of existing spec text on type 2 UE.

## Whether type 2 UE is supported in R16

**Background**: As stated in [5], the following was agreed in RAN1#100bis e-meeting [6].

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| * RAN1 agreed to update FG8-1 “Dynamic power sharing for LTE-NR DC” for Rel-16 so that Rel-16 UEs are required to set the capability bit for FG8-1 to 1 i.e., supported. This is applied from Rel-16 (not to Rel-15). |

With this agreement, dynamic power sharing is mandatory for Rel.16 EN-DC UE, i.e., type 2 UE is not allowed in Rel.16.

The following TP was proposed to capture the above agreements.

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| ---------------------------- 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 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]).  ---------------------------- end TP1 to sub clause 7.6.1 of 38.213v16.1.0 -------------------------------------- |

***Tentative Proposal****: discuss and confirm that type 2 UE is no longer supported in R16, and whether text related to R16 type 2 UE behavior should be removed from the spec***.**

***Question #1*:** Do we agree that type 2 UE is no longer supported in R16? If so, should we also remove the corresponding R16 type 2 UE behavior from the spec (similar as the TP above)?

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| Company | Comments |
| Apple | Based on the agreements in the LS [6], our understanding is the dynamic power sharing is mandatory for Rel.16 EN-DC UE. Thus, the type 2 UE is not allowed, and related text can be removed from the spec. |
| ZTE | Based on the outcome of Rel-16 UE feature discussion, Rel-16 UE is mandated to support dynamic power sharing for EN-DC. Thus, the issue raised in this TP is valid. |
| MTK | We agree on the tentative FL proposal. |
| Qualcomm | The statement of the LS in [6] is valid. However, the change is not essential. Keeping it does not impact on anything. |
| Nokia | Agree with the proposed change. |
| Samsung | Agree with the FL’s proposal and then Rel-16 UE behavior for type 2 can be removed in the spec. |

## HARQ-offset for TDD Pcell EN-DC

**Background**: In RAN1#98 meeting, the following agreements were reached. HARQ-offset is optional for type1 UE in EN-DC with LTE TDD PCell, but for type2 UE, it is FFS.

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| Agreements:   * Regarding the FFS part (in change marks) in the agreement from RAN1 #96bis:   For DL HARQ timing corresponding to the DL-reference UL/DL configuration used in single Tx in EN-DC with TDD Pcell, the following is agreed:   * For LTE DL CA, the SCell uses the same DL-reference UL/DL configuration as the PCell (already agreed in RAN1 #96bis)   + For the LTE TDD SCell with different UL/DL configuration (as in SIB1) as the TDD PCell: use the PDSCH ACK timeline for SCell as in case of LTE FDD-TDD CA with LTE TDD PCell (i.e. Table 10.1.3A-1 in 36.213)   + For the LTE TDD SCell with the same UL/DL configuration (as in SIB1) as the TDD PCell: use the same PDSCH ACK timeline as the LTE TDD PCell (i.e. Table 10.1.3.1-1 in 36.213) * Support HARQ-offset for SUO case1 in EN-DC with LTE TDD PCell * Note: from UE perspective, it is expected that HARQ-offset value doesn’t violate the DL/UL configuration (in SIB1). * For type 1 UE, the feature is optional. FFS for type 2 UE. |

Two issues relate to HARQ-offset were raised [1][4],

1. Where/how to capture the agreement“For type 1 UE, the feature is optional”
2. Is HARQ-offset mandatory or option for type 2 UE.

FL’s understanding on the issue: as discussed in 2.1, dynamic power sharing is mandatory for Rel16 EN-DC UE. Therefore, it would be helpful to first conclude on issue in 2.1, and then decide if this issue need to be further discussed or not.

***Tentative Proposal****: first conclude on issue in 2.1 before further discussion.*

***Question #2*:**

1. Is there any further discussion needed to conclude on the “FFS” part for R16 type 2 UE support of HARQ-offset?
2. Is there any extra change/discussion needed in RAN1 spec to capture that HARQ-offset is optional for R16 type1 UE with LTE TDD PCell? Or leave it to RAN2 spec, e.g., TS 38.331 description and RAN1 UE feature list description?

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| Company | Comments |
| Apple | Question a): according to the agreements in [6], no need to discuss the FFS part for type 2 UE anymore.  Question b): “For type 1 UE, the feature is optional” this agreement is not captured in the spec yet. We have no strong opinion to capture it in RAN1 spec or RAN2 spec, just follow the majority view, the draft TP can be prepared correspondingly. |
| ZTE | Question a): Based on the outcome of Rel-16 UE feature discussion, Rel-16 UE is mandated to support dynamic power sharing for EN-DC. Thus, it seems not needed to further discuss this issue.  Question b): We prefer to leave it to RAN2 spec. There are so many optional RRC parameters, it would be cumbersome if we plan to add “if applicable” after all the optional RRC parameters in RAN1 spec. |
| MTK | Question a): As mentioned by Apple and ZTE, no need to further discuss this issue.  Question b): We prefer to leave it to RAN2 spec. Same reason as ZTE. |
| Qualcomm | According to [6], no need to clarify the FFS for Type 2 UE. However, we already have an agreement at RAN1#100bis-e based on the TP from R1-2002999. We should make a conclusion on how to handle the agreement. |
| Nokia | In our understanding, there is no direct impact to the RAN1 specification, and the optional/mandatory decisions should be taken care of in the UE feature list. However, we would need to conclude on whether the feature is optional or mandatory for type 2 UEs, and as this is an FFS point under this agenda, we should either take the discussion here, or decide that we will defer the discussion to UE capabilities agenda. Both are OK to us. |
| Samsung | Agree with the FL’s proposal.   1. No need to further discuss it. 2. We are fine to leave it to RAN2. |

## On type 2 UE supporting dual Tx

**Background**: There is clarification issue raised in [3] on whether or not R16 type 2 UE should support tdm-pattern-dualTx. The observation is that [3], according to Rel-15 38.306, for UEs that do not support dynamic power sharing, it is mandatory to support *tdm-pattern* (case1 HARQ timing). In this case, it seems Type 2 UE is not able to support *tdm-pattern-dualTx* according to current understanding.

However, similar as for issue discussed in 2.2, it would be helpful to first conclude on issue in 2.1, and then decide if this issue need to be further discussed or not.

***Tentative Proposal****: first conclude on issue in 2.1 before further discussion. If type 2 UE is not supported in R16, there is no need to further discuss.*

***Question #3****: any further discussion needed to clarify whether R16 type 2 UE should support tdm-pattern-dualTx?*

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| Company | Comments |
| Apple | Rel.16 Type 2 UE related issues don’t need to be discussed anymore. |
| ZTE | Based on the outcome of Rel-16 UE feature discussion, Rel-16 UE is mandated to support dynamic power sharing for EN-DC. Thus, it seems not needed to further discuss this issue. |
| MTK | We see further discussion needed.  According to the RAN1 #98 agreement show below, it seems case 1 HARQ timing applying to dual UL tx UE is also applicable in R15. Therefore, clarifying this issue in R16 may also help clarify the R15 behavior.  Agreements:  R15 specification on “DL HARQ timing for FDD Scell for LTE TDD-FDD CA with TDD Pcell, **applied to FDD Pcell**” (i.e., case1 HARQ timing in single UL), is applied to EN-DC UE capable of dual UL Tx in EN-DC with LTE FDD PCell to **mitigate DL de-sensing due to Harmonics**, at least including:   * UE behavior specified in 36.213 and 36.212 * FFS: all uplink subframes can be scheduled for LTE |
| Qualcomm | No need to discuss this. |
| Nokia | Indeed, it appears that Type 2 UEs don’t exist in Rel-16 and that closes the discussion. The agreement MTK references to seems to be about the Rel-15 behaviour being used as-is in Rel-16 dual-Tx, but later we separated the two UEs and the configurations with different UE capabilities and RRC configurations. |
| Samsung | Agree with the FL’s proposal. |

# Issues related to Type 1 UE

A few issues related to type 1 UE handling were raised in [1][2][3][4].

## TP to capture RAN1 agreements on UE dropping behavior

**Background**: it was raised in [2][3] the current description in 38.213 is confusing when capturing type 1 UE behavior for ‘single-tx’ regarding the handling of collision and dropping, as the corresponding text is under the condition “*If a UE is configured with …*”. However, for single-tx case, the UE cannot transmit simultaneously on LTE and NR regardless of the*, * settings. So, the behavior of dropping NR should logically be specified outside the ** condition/assumption.

This same issue has been brought up and discussed in both RAN1 #100e and RAN1#100bis-e, and two alternative TP’s were proposed and discussed extensively. Unfortunately, no consensus was reached. In this meeting, [2] [3] raised the issue again and proposed the TP option 2, which is listed below:

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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 |

FL’s understanding on the issue : The issue was discussed in two consecutive meetings and there is no consensus or sign of potential compromise over the two TP options. The chairman has already concluded no spec change in the last meeting. In addition, I highly doubt there would be any new argument brought during this meeting and or any change of position. Therefore, I would recommend we don’t continue discussion this issue. But I would like hear if this is the common view or any new argument that can be raised to help the decision.

***Tentative proposal****: don’t continue discussion on this issue, unless there is consensus otherwise and new argument raised to help the decision*.

***Question #4***: Do we see any need to continue discussing the TP, considering we failed to reach consensus on the same issue in the past 2 meetings? Or any new argument we want to bring for the discussion?

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| Company | Comments |
| Apple | Following RAN1 chair’s guidance in last meeting “Thanks for the continued discussion. Then let’s keep the spec as is for the issue in question.” To us, the issue is done, is this common understanding? or we need to ask RAN1 chair to clarify the guidance, hope not. |
| ZTE | Same view with Apple. |
| MTK | We see the need to continue discussing the TP.  To our understanding, RAN1 chair’s guidance “to keep the spec as it” is for last meeting, and it does not prevent further discussion. We think Option 2 reflects previous RAN1 agreements in a better way. Leaving this issue would create some ambiguity when companies try to interpret the spec in the future. |
| Qualcomm | The conclusion has been made already. No need to discuss this. |
| Nokia | We would be interested in resolving the issue, but suspect that having the same debate in the 3rd meeting in a row is unlikely to yield any different result than in the previous two meetings. |
| Samsung | Agree with the FL’s proposal. We believe the issue was already done. |

## Type 1 UE capability with semi-static UL transmission

**Background:** In RAN1#99, the following agreements were reached, concluding that whether the semi-static configured UL transmissions are allowed in all UL subframes is subjected to UE capability.

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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 |

To capture these agreements in RAN1 spec, two text proposals are provided [1] by for TS 38.213 and TS 36.213, respectively, as referenced below:

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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*. |

***Tentative proposal****: discuss and decide on the proposed TP.*

***Question #5****: should we discuss and finalize the TP based on the one above in this meeting to reflect the corresponding RAN1 agreement?*

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| Company | Comments |
| Apple | Based on last meeting UE feature discussion, and an LS sent to RAN2, we believe the UE feature is stable, we can discuss the details of the TP in this meeting. |
| ZTE | This issue needs to be resolved, otherwise the spec is not completed. |
| MTK | We agree to discuss the corresponding TP. |
| Qualcomm | OK to discuss the TP |
| Nokia | OK to discuss the TP |
| Samsung | Agree with the FL’s proposal. |

## Clarifications on UE behaviour in collision

**Background**: as mentioned in [3], the UE behavior upon UL transmission collision is captured in the spec using text like “UE does no transmit…” or “UE is not expected to transmit…”. Which seems ambiguous. The following clarification is proposed in [3]:

*Proposal 3: Clarify that “the UE is not expected to transmit”/” UE does not transmit” in LTE/NR spec is equivalent to*

* *“the UE is not expected to be configured or indicated to transmit”, or*
* *“UE still needs to handle LTE/NR collision while the handling is up to UE implementation since it is not specified in spec”*

FL understanding on the issue: if the concern is on type 2 UE, then it may be related to the discussion in section 2.1, and there may be no need to further clarify any type 2 UE behavior (depending on the consensus for discussion in 2.1). If the concern is on type 1 UE, then it seems that the wording is clear, i.e., UE will handle the collision by not transmitting on the SCG. Therefore, it doesn’t seem to be strong need to further clarify. But will see how other companies respond.

***Tentative proposal****: No need for further clarification, at least for type 1 UE.*

***Question #6****: do we need to further clarify for the text above, as proposed in [3]?*

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| Company | Comments |
| Apple | For type 2 UE, it’s not necessary to clarify.  For type 1 UE, the second bullet doesn’t need to clarify as well, as the UL transmission collision rule was already defined for type 1 UE. The first bullet was discussed in previous meeting, no consensus was reached. |
| ZTE | Same view with Apple. |
| MTK | Since type 2 UE would not be supported in Rel-16 anymore, it may be fine to leave current spec as it is. However, if some companies prefer some further clarification, we are fine to discuss it. |
| Qualcomm | The TP in 3.2 contains the wording. If we discuss the TP in 3.2, we would need to discuss the issue. |
| Nokia | We don’t agree that “The UE is not expected to transmit” which sets the action/inaction determination on the UE would mean that the UE is not expected to be configured or scheduled to transmit which sets the action/inaction determination on the gNB. We don’t see any ambiguity in the current wording. |
| Samsung | Agree with the FL’s proposal. Also, no need to discuss it for type 2 UE. |

# References

1. R1-2003325, “Remaining Issues of Single Tx for EN-DC”, ZTE, 3GPP RAN1#101 e-meeting, May 25th – June 5th, 2020
2. R1-2003502, “Enhancements for single UL operation for EN-DC” ,Huawei, HiSilicon, 3GPP RAN1#101 e-meeting, May 25th – June 5th, 2020
3. R1-2003673, “Remaining issues on single Tx switched uplink solution for EN-DC”, MediaTek Inc., 3GPP RAN1#101 e-meeting, May 25th – June 5th, 2020
4. R1-2004238, “Remaining issues on single Tx operation for EN-DC”, Apple, 3GPP RAN1#101 e-meeting, May 25th – June 5th, 2020
5. R1-2004362, “Remaining issues for single Tx UL enhancements”, Ericsson, 3GPP RAN1#101 e-meeting, May 25th – June 5th, 2020
6. R1-2003072, “LS on Rel-16 RAN1 UE features lists for NR”, RAN WG1, 3GPP RAN1 #100-e, April 20th - 30th, 2020.