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3GPP TSG RAN #93 RP-212118

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Views on 3TX UE for Rel-18

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Background

- 3Tx discussion in **[RAN#93e-R18Prep-17]**
  - 3Tx UE was proposed and discussed in the pre-RAN#93 discussion, including the following potential scope

    1. Power enhancement with 3Tx
    - UE max power can be improved with 3Tx, e.g. the power can reach 31dBm with 3 PC2 PAs, and 30dBm with 1PC3+2PC2 PAs, etc.
    - Potential power enhancement approaches could be introduce new power class, or remove Pcmax upper limit, or apply power boosting, etc.

    2. MIMO enhancement with 3Tx
    - 3 layer MIMO can be supported in 1CC or 2 contig CC
    - 2 layer MIMO can be supported in non-contig UL CA, inter-band UL CA, or EN-DC at one CC which are currently not be able to be supported with 2Tx assumption
    - TxD with 3Tx can be supported if interested

    3. 3CC or 3 bands Tx simultaneously
    - 3 bands with 1Tx in each band concurrent transmission can be supported, e.g. in UL CA or EN-DC

    4. Tx switching transmission enhancement
    - With 3Tx, low band and high band 3Tx concurrent transmission can be achieved
  - In this paper, we share our views on 3Tx in Rel-18.

Power enhancement with 3Tx

- Power Class
  - Currently, the defined power class are PC1, PC1.5, PC2 and PC3
    - PC3 (23dBm) is the default power class, and PC2 (26dBm) TDD is also optionally supported by handheld UEs
    - PC1 (31dBm) and PC 1.5 (29 dBm) are supported by non-handheld UEs, e.g. CPE/FWA
  - If we use 3Tx to achieve current Power class, then this is not a good approach. Based on the discussion in RAN4 TxD WI, from UE product development perspective, less Tx chain is preferred to achieve the same power level, to reduce the cost, heating dissipation and complexity.
  - If we use 3Tx to achieve new higher power class, then clear usage scenario with power larger than maybe 29dBm or 31dBm should be identified, especially for handheld UEs.

- Our views
  - **For power enhancement, CPE with 3Tx can be considered.**
  - **Handheld UE with 3Tx just for PC3 and PC2 power enhancement is meaningless, since less Tx chain is better to achieve the same power level.**
  - **For PC 1.5, 2Tx with 26+26 is sufficient. For PC1 with 31dBm, we really doubt the current market demand for a smartphone to support PC1, same as FWA!**
  - **Even for Handheld UE to support PC2 HPUE, 2Tx is still Rarely used in the industry, one Tx with 26dBm is the main approach.**
  - **From Power enhancement perspective, we do not think 3Tx is needed for Rel-18.**

MIMO enhancement with 3Tx

- 3 layer MIMO
  - Currently, 3 layer MIMO is supported for 4Tx UE in RAN1 spec however 3Tx MIMO (codebook) is not defined.
  - TxD with 2Tx is still not finalized in RAN4, therefore 3Tx TxD is so early.
  - Looking back the history of multi-chain specification development, the 2Tx discussion in RAN4 was started after RAN1 had clear 2Tx MIMO supporting.
  - Without RAN1 support, the 3Tx architecture should not be discussed in RAN4.
  - We also need to understand if significant improvements can be made to justify the time spent on this.

- Our views
  - **For 3Tx MIMO (codebook) or 3Tx TxD, this feature should be discussed in RAN1 first.**
  - **Without RAN1 supporting 3Tx, this architecture should not be discussed in RAN4.**
  - **3Tx MIMO (codebook) is RAN1 working scope.**

3CC or 3 bands Tx simultaneously

- Support of 3 bands
  - 3 bands with 1Tx in each band concurrent transmission impact, e.g. in UL CA or EN-DC, however,
    - The interference among 3 bands is very challenging and complex
    - Implementation difficulty, coexistence and triple beat MSD issues
    - One more TX chain will increase UE circuitry area and complexity, power consumptions and heating dissipation, as well as UE cost
    - Not clear usage cases

- Our views
  - **Since the benefits and use cases are not clear, and the drawback of this feature supporting at this stage is huge, we do not support 3 bands Tx simultaneously for Rel-18.**

Tx switching transmission enhancement

- Tx switching
  - With 3Tx, low band and high band 3Tx concurrent transmission impact (2 band),
    - One more active power supply and RF chain would add more interference/thermal effect/Power consumption
    - The resource in high band generally much more than low band, overall performance of further adding lower power chain simultaneously may not be promising

- Our views
  - **UE supports TX switching then it will be 2 TX. Supporting 3Tx simultaneously is not much beneficial.**
  - **Since FDD HPUE is under discussion, potential Tx switching enhancement including FDD HPUE can be considered.**

Standardization progress of 2Tx

- The progress of 2Tx
  - TxD is now a Rel-17 WI that still on going,
    - Key requirements had just been agreed that not included in spec yet
    - Unsettled issues still exist for different architectures and requirements
    - Challenges still exist for performance stability in the field for 2Tx compared to 1Tx with same transmission power
    - Few product in the market yet, if exist.

- Our views
  - **The progress of 2Tx requirements is still on going with unsettled issues in requirements and potential degradation in the field.**
  - **It is too early to start 3Tx handheld UE discussion.**

In summary

- 3Tx study can be studied from large form factor devices FWA/CPE
- For Power enhancement with 3Tx, the benefits is quite limited
- For 3Tx MIMO, this should be RAN1 working scope. RAN4 should start the discussion of 3Tx, after RAN1 finalize 3Tx MIMO (codebook).
- For 3 bands Tx simultaneously, the benefits and use cases are not clear, and the drawback of this feature supporting at this stage is huge.
- For Tx switching transmission, potential enhancement potential Tx switching enhancement including FDD HPUE can be considered.

- **In short, overall we do not support 3Tx for handheld UE within Rel-18 timeline.**

THANK YOU.
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