3GPP TSG-RAN Meeting # 103
Maastricht, Netherlands, March 18-21, 2024

RP-240453
Agenda Item 9.1.4.1

MediaTek Views on RAN4 Rel-19: RF

MediaTek Inc.

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Outline

- HPUE CA
- Power Boosting / MPR Reduction
- 6Rx

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RAN4 Rel-19: HPUE CA views

UE RF: High power UE (HPUE) for CA in TN

- References: RP-233918
- Potential objectives:
  - High power UE (HPUE) for CA (non-spectrum item for the combinations which need generic requirements)
    - PC1.5 UE for intra-band contiguous CA with or without UL MIMO with 2Tx
    - PC1.5 UE for two band inter-band CA with 2Tx and/or 3Tx for handheld and FWA
      - 3Tx specifics: Also PC2?; EN-DC? (1)
    - Generic framework of support increasing UE power high limit for inter-band CA HPUE (only for TN) for different power classes
      - Do we need a study phase, e.g.. in 2Q'24 (1 quarter)? (2)
  - Further discussion on other type of HPUE CA band combinations. (3)
  - Further discussion on whether to introduction of HPUE for EN-DC (3)
  - Further discussion on whether to introduce PC1.5 for intra-band non-contiguous (3)

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1. **3Tx specifics:** Include **3Tx switching (2T+1T <-> 1T+2T)** to boost UL MIMO availability with total 3 Tx chains across 2 frequency bands – **see slide**
2. **Generic Framework for UE power limit:** more than 1 quarter study is recommended to ensure any such framework is clear
3. Prioritize **"Inter-band CA"**

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3Tx for 2 bands with UL Tx switching between 1T+2T and 2T+1T

- Motivations
  - 3Tx across 2 bands introduced for non-handheld devices in Rel-18 enables UL MIMO on one band and single UL on another band, as well as increasing UL Tx power
  - Both FDD and TDD UL MIMO operation gain market traction
  - However, lack of spec support for 1T+2T <-> 2T+1T UL Tx switching means UL MIMO and Tx power capability cannot not be flexibly/dynamically allocated between carriers
  - This means that MIMO and UL Tx capability of the device cannot be fully utilized to maximize uplink experience in the presence of varying SINR conditions and varying UL cell resources availability across the 2 bands
    - E.g. FDD+TDD combination: TDD band has no UL resources available for ~70% of the time compared to FDD uplink
  - Support for 1T+2T <-> 2T+1T switching would overcome this drawback

- Objectives
  - Specify UL Tx switching across 2 bands with restriction of up to 3 Tx simultaneous transmission for FR1 UEs, In particular, UL Tx switching is performed between 1T+2T and 2T+1T for a 3Tx capable UE
  - Support the following configurations:
    - Single UL CC per band (1CC+1CC)
    - Single UL on one band and CCA on the other band (1CC+2CCA)
  - Specify the following RAN4 requirements for the scenario
    - Length of switching period
    - Time mask RF requirements
    - Uplink interruption and downlink interruption (RRM) requirements, if needed
  - Note: “Minor” updates to RAN1 (for additional switching cases) and RRC configuration update also needed – can be done via LS

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RAN4 Rel-19: Power boosting/MPR reduction views

UE RF: Power boosting and/or MPR reduction

- References: RP-233918
- Potential objectives:
  - 1 **(Ensure reasonable load)** Power boosting or MPR reduction for PC2/PC3 with ACLR relaxation with BS indication (Study on whether and how much the requirement can be relaxed first and how often the power boosting can be done, and at least lower modulation order need be studied and FFS on higher modulation order) for FR1 and FR2
    - A study phase is necessary
    - Is there a need to consider RedCap?
  - 2 MPR reduction for UL contiguous CA in FR1/FR2
    - How about a single active UL carrier case when CA is configured?
  - ~~MPR reduction for RedCap via relaxed emission requirements with BS indication (Study on whether and how much the requirement can be relaxed first, and at least lower modulation order need be studied)~~
  - ~~Need further clarification and discussion on including Pi/4 QPSK in the study and check whether there is RAN1 impact~~
  - ~~Need further discussions on whether PAPR reduction is included.~~
  - ~~Need further discussion on whether EVM will be relaxed.~~
  - ~~Need further discussions on whether the power boosting or MPR reduction should be network transparent only~~

MediaTek views **See slide, slide**

1. Power boosting scope: **RedCap UE** in >20MHz spectrum block is the most natural case where gain from ACLR/SEM relaxation is achievable
   - There is no justification to exclude RedCap
   - More relevant aspects to consider in constraining the Power Boosting workload are:
     - Clarify that focus shall be on **existing reference Tx PA models and waveforms**, not improved PA models
     - Clarify whether relaxation is allowed only when UE CBW < spectrum block size, or also when UE CBW = spectrum block size
     - Higher order modulation is EVM limited, so unclear what the proposal is for that in context of ACLR relaxation
2. CA MPR: Focus on (configured) single CC UL scenarios: most relevant operating scenarios

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Power boosting and MPR reduction

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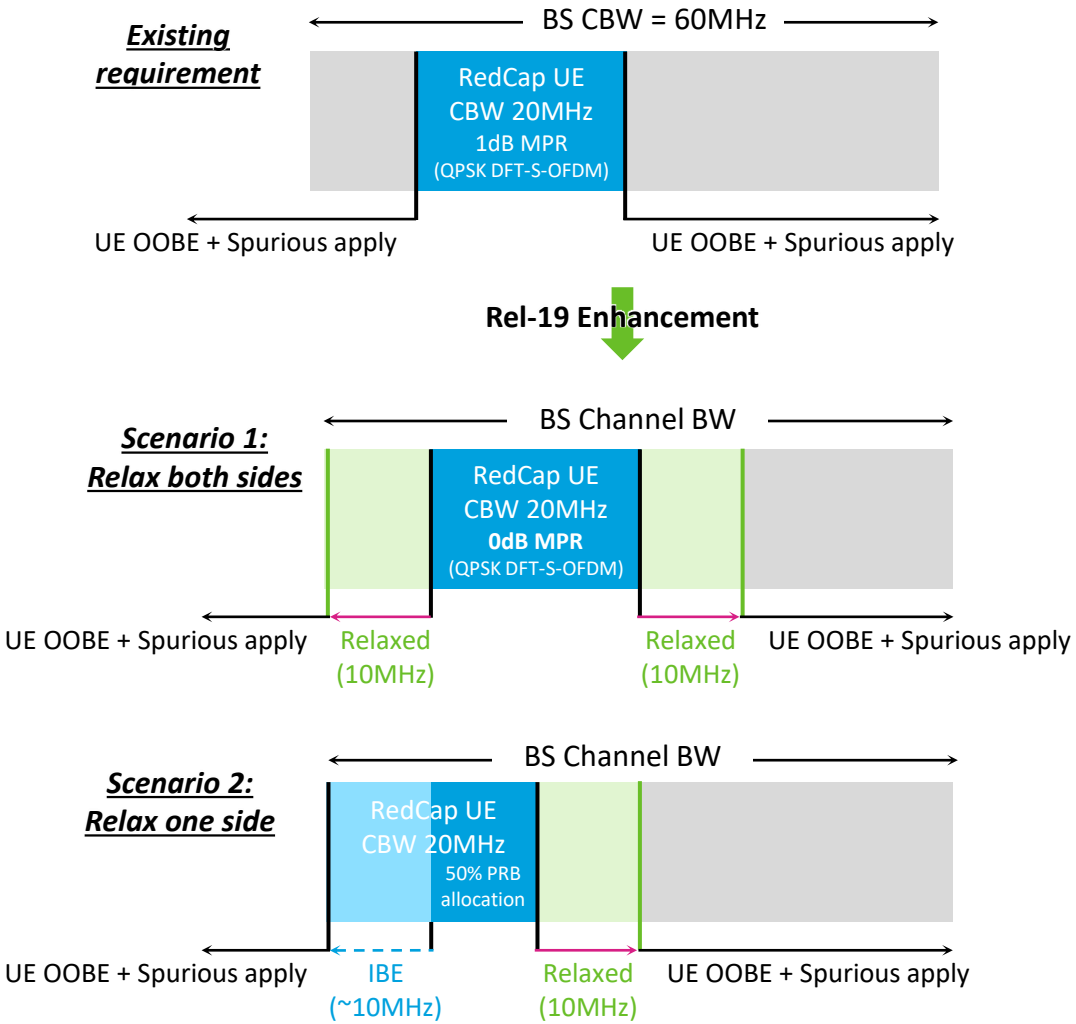
FR1 MPR reduction for RedCap UE

- Motivation
  - Improve RedCap UE UL Tx power via MPR reduction without device cost increase
  - RedCap UE will operate in TDD spectrum blocks >>20MHz
    - But required to fulfil ACLR/SEM/Spurious reqs from edge of 20MHz UE CBW – independent of where it is located in the spectrum block
    - Shifting start of OOB and Spurious by 10MHz from UE channel edge can enable reduction of MPR (up to 1dB or 1.5dB in PC3, depending on waveform/mod.)
  - **Observation:** Relaxed OOB+Spurious emissions for RedCap UE operating in RBs 10MHz away from spectrum block edge can enable MPR of "outer RB" allocations to be reduced <u>without</u> changing RAN4's Reference UE Tx model and device complexity.
  - NW to control (per UE) whether UE should operate with "relaxed ACLR/SEM/Spurious" in a channel. Existing reqs apply otherwise

Table 6.2.2-1 Maximum power reduction (MPR) for power class 3

Modulation		MPR (dB)		
		Edge RB allocations	Outer RB allocations	Inner RB allocations
DFT-s-OFDM	Pi/2 BPSK	≤ 3.5[1]	≤ 1.2[1]	≤ 0.2[1]
		≤ 0.5[2,3]	≤ 0.5[2]	0[2,4]
	Pi/2 BPSK w Pi/2 BPSK DMRS	≤ 0.5[2,3]	0[2]	0[2,4]
	QPSK	≤ 1		0[5]
	16 QAM	≤ 2		≤ 1
	64 QAM	≤ 2.5		
	256 QAM	≤ 4.5		
CP-OFDM	QPSK	≤ 3		≤ 1.5
	16 QAM	≤ 3		≤ 2
	64 QAM	≤ 3.5		
	256 QAM	≤ 6.5		



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Power boosting and MPR reduction

[2/2]

Suggested components of study

- Background:
  - **RAN4 already did** analysis/improvement in Rel-18 of Tx power improvement for **"inner RB" allocations** (where EVM is typically most limiting)
  - **RAN4 did not cover "outer RB" allocations** for lower order modulations (where ACLR and SEM is typically most limiting)
  - **MediaTek RAN Rel-19 WS proposal (June 2023)**
    - Regarding ACLR impact outside of the operator's spectrum block, MediaTek proposed consideration of inter-operator scenario during **June 2023** RAN Rel-19 WS on RWS-230119 (also see extract from meeting report).
      - *MediaTek: clarification to slide 2: the proposal "Power domain improvements" (RAN4-led) is to evaluate whether, in the increasingly prevalent operating scenario of site-sharing (between MNOs/RATs), relaxation of UE Tx emission requirements (normally set under a "non-colocated base station deployment" assumption) could be feasible, and whether this could enable subsequent improvement of UE MPR requirements specifically for that scenario*
    - However, to apply this generically would need adjacent channel coexistence simulation effort in RAN4, may be high workload. Clarification is needed on the scenario constraints otherwise.

- Suggested components of study
  - Focus on improving Tx power to reduce MPR of outer RB allocations (to reduce MPR difference vs inner RB allocation) as a trade-off with ACLR/SEM/Spurious emissions relaxation when operating scenario allows it
  - Identify the scenarios where this would be feasible
    - At least include the case where UE is operating in RBs within 0.5 x UE BW from spectrum block edge – consider RedCap and normal UE (impact inside operator's spectrum block)
    - TBD whether to also include the case where UE is operating in RBs closer to the spectrum block edge (impact outside operator's spectrum block)
  - Pre-requisites: No waveform adaptation/manipulation vs R15, re-use of R15 PA/Tx reference model assumptions
  - Identify mechanism for network operator to control usage of any such new UE behaviour

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RAN4 Rel-19: 6Rx views

UE RF: 6 Rx

- References: RP-233918
- Potential objectives:
  - Do we need a feasibility study?
  - 1 Investigate and enable 6Rx on higher frequency bands (>2.5GHz) targeting at support of smartphone and FWA
  - Specify the requirements to support SRS antenna switching
  - 2 FFS on the MIMO layer to be supported.
  - Further discussions on the following potential objective:
    - 3 Improved SRS reporting for antenna switching usage

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1. Need for FWA 6Rx capability unclear (vs. 4/8Rx)
2. Focus on 4 layers: Most practical
3. SRS insertion loss reporting: no gain observed
   - UE can/should self-compensate for power imbalance from insertion loss by using available Tx power
   - SRS insertion loss reporting as alternative has been shown to be inferior to UE self-compensation (see e.g. R1-2308034)

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Thank you!

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