

**3GPP TSG RAN Rel-19 workshop**

**RWS-230251**

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**Agenda Item:**

**5**

**Document for:**

**Discussion**

# **Multi-carrier enhancements for NR**

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## ■ Rel-18 Multi-carrier enhancements for NR

- To increase flexibility and spectral/power efficiency on scheduling data over multiple cells including intra-band cells and inter-band cells while reducing the control overhead
  - » Multi-cell PUSCH/PDSCH scheduling (one PDSCH/PUSCH per cell) with a single DCI
- To achieve higher UL data rate, spectrum utilization and UL capacity even with practical limitation on number of Tx chains at UE
  - » UL Tx switching across up to 4 bands with restriction of up to 2 Tx simultaneous transmission for FR1 UEs

## ■ Motivation for further enhancements

- There have been quite high commercial demands for 1) efficient use/expansion of FR2 and 2) UL performance improvement
- For majority of UEs (e.g., smartphones), supporting multiple carriers/bands is typical and hence there may be some mechanisms/procedures that can be optimized e.g., from per-cell to per-set of cells
- Due to limited TUs for Rel-18 MCE, the Rel-18 solutions may not be able to address some of important use-cases and original motivations

- **For improvement of FR2 usage and UE power saving, multi-cell scheduling enhancement should be considered in Rel-19**
  - Multi-cell scheduling + multi-slot scheduling via single DCI
    - » Motivation: Multi-cell scheduling from FR1 cell to FR2 cells is beneficial to save UE power consumption for PDCCH monitoring, and the combination with multi-slot scheduling can achieve efficient scheduling of multiple FR2 cells having higher SCS than that of FR1 scheduling cell.
  - MC-DCI and legacy DCI monitoring on different scheduling cells for a scheduled cell
    - » Motivation: Utilizing legacy DCI on self-carrier for scheduling retransmission is beneficial for offloading PDCCH transmissions from scheduling cell of MC-DCI and not requiring cross-carrier scheduling capabilities to UE.
  - Improving MPR for intra-band CA in FR2 (maybe as part of RAN4 RF enh WI in Rel-19)
    - » Motivation: In current RAN4 specification, FR2 CA MPR is defined based on not only UL CBW but also DL CBW and hence even if there is only one UL carrier configured for a UE, MPR is very high when UE is configured with multiple DL carriers. So, in practice, UE needs to be re-configured with reduced number of DL carriers when UL power is not sufficient due to large MPR.

- **For improvement of UL throughput performance, further UL enhancement can be considered in Rel-19**
  - UL transmission on a carrier without corresponding DL carrier (i.e., UL only cell)
    - » Motivation: This concept was argued and discussed at the initial phase of Rel-18 MCE WI, but it was quickly dropped concerning workload. It would be beneficial to study this concept which leads to more flexible use of a carrier assuming multiple carriers/bands available for a UE.
  - Potential enhancement on UL Tx switching (low priority)
    - » Motivation: UL Tx switching across up to 4 bands was introduced in Rel-18 and further enhancement such as more than 4 bands would not be urgent and essential. Some other possible enhancements are 1) more than 1 intra-band CA bands with 2 contiguous carriers each and 2) more than 2 intra-band contiguous carriers within a band, but use-case and feasibility are unclear. Another possible enhancement is for 3 Tx (1Tx+2Tx), but it depends on RAN4 study on 3 Tx.

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