

3GPP TSG RAN Rel-19 workshop
Taipei, June 15 - 16, 2023
Agenda Item: 5
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RWS-230236



Multi-carrier enhancements for Rel-19

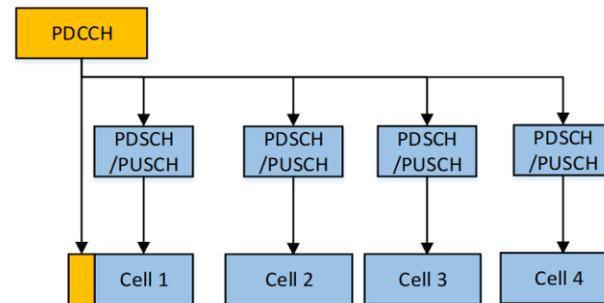
China Telecom
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■ The Rel-18 objective for multi-carrier enhancement includes

- » Multi-cell PUSCH/PDSCH scheduling with a single DCI
- » Multi-carrier UL Tx switching across 3 or 4 bands

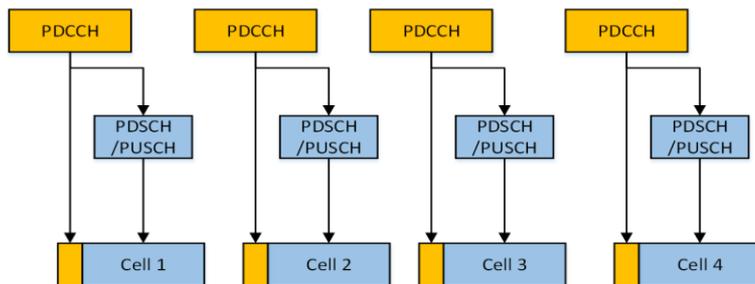
■ Multi-cell scheduling with a single DCI is specified in Rel-18 with the following properties and down scoped due to the limited TU

- » The same SCS, carrier type (licensed or unlicensed, FR1 or FR2-1 or FR2-2) among co-scheduled cells
- » Different TBs are scheduled on different cells
- » Up to 4 cells can be scheduled by a single DCI
- » One scheduling cell for each scheduled cell
- » Monitoring the MC scheduling DCI and legacy DCI from a same scheduling cell
- » No simultaneous configuration of CBG-based PDSCH/PUSCH and MC scheduling within a same PUCCH group
- » No simultaneous configuration of multi-PDSCH scheduling and MC PDSCH scheduling within a same PUCCH group
- » Exclude SCell scheduling multiple cells including P(S)Cell
- » Exclude PCell scheduling multiple cells when a sSCell is configured to schedule Pcell

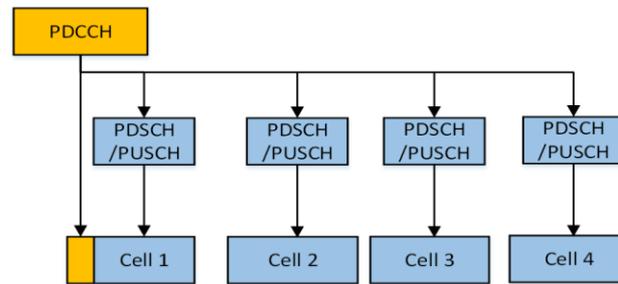


■ Motivation

- » The deployment of multi-carrier operation can have different SCS for the aggregated cells. Extending the single DCI scheduling for multiple PUSCH/PDSCH on cells with different SCS makes the **control overhead reduction** benefit applied for **more deployment scenarios**.
- » One example for the benefited deployment scenario is typical 3.5GHz TDD + Sub-3GHz FDD.



Rel-18 MC scheduling for cells with different SCS



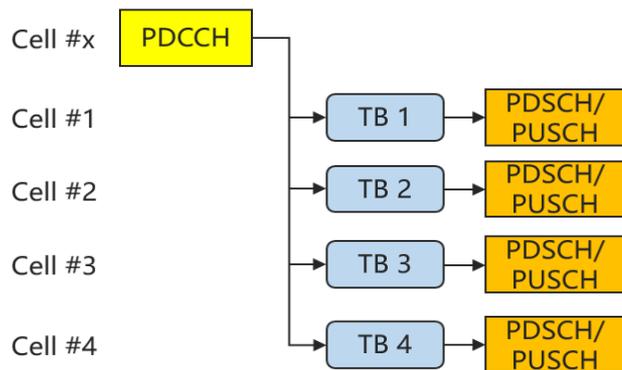
Rel-19 MC scheduling for cells with different SCS

■ Objective

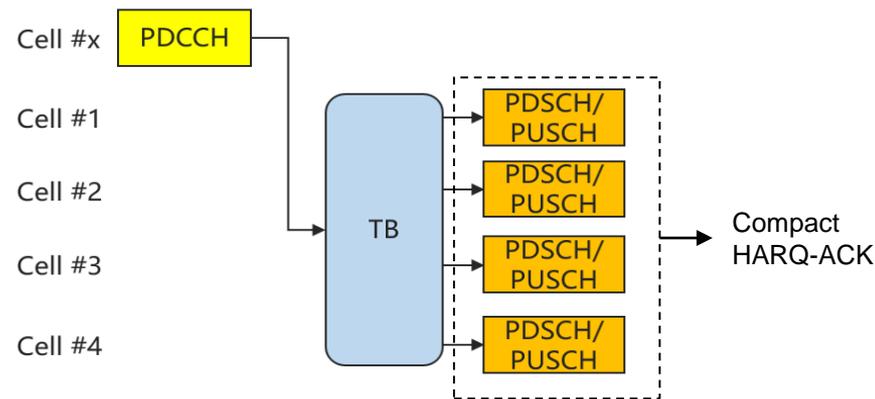
- » Extend multi-cell PUSCH/PDSCH scheduling with a single DCI to support **different SCS among co-scheduled cells**

Motivation

- » When one aggregated TB is scheduled for multiple DL/UL data channels (PDSCH/PUSCH) on different cells by a single DCI, it can have **overhead reduction** and **higher channel coding gain**. For example, the overhead of CRC and HARQ-ACK feedback can be reduced.



Rel-18 MC scheduling with different TBs on different cells



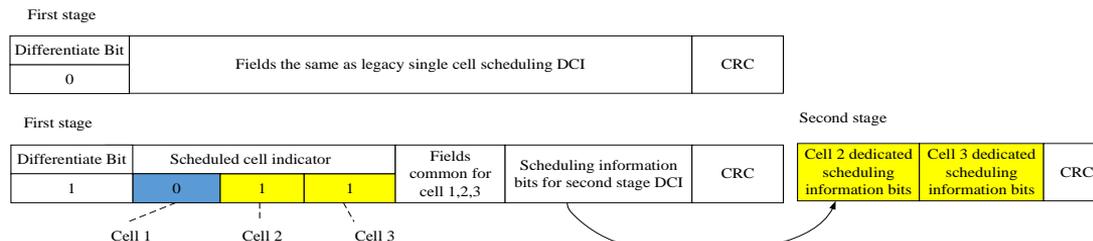
Rel-19 MC scheduling with aggregated TB mapped on different cells

Objective

- » Extend multi-cell PUSCH/PDSCH scheduling with a single DCI to support **one aggregated TB mapped on co-scheduled cells**

Motivation

- » For the MC scheduling DCI designed in Rel-18:
 - With the maximum DCI size limited to 164 bits including CRC, **up to 4 cells** can be scheduled by one DCI.
 - The actually scheduled cells are indicated dynamically by the MC scheduling DCI. However, The payload size of the MC scheduling DCI does not scale with the number of actually scheduled cells. When the actually scheduled cells are less than the maximum cell number of all the co-scheduled cell combinations or cell number within the set of cells, **the type 2 field bits for the not scheduled cells are wasted.**
- » If the MC scheduling DCI is designed containing 2 stages
 - The payload size is split into two parts with the size of each part not larger than the maximum size limitation, thus **more cells can be scheduled by the DCI.**
 - The first stage DCI contains the scheduled cell indicator, common fields for multiple scheduled cells, scheduling information bits for second stage DCI. The second stage DCI contains dedicated fields for the actually scheduled cells, and the size is changed corresponding to the actually scheduled cells. So that there are **no wasted DCI bits for the not scheduled cells.**

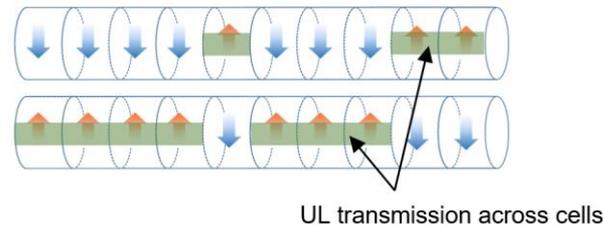
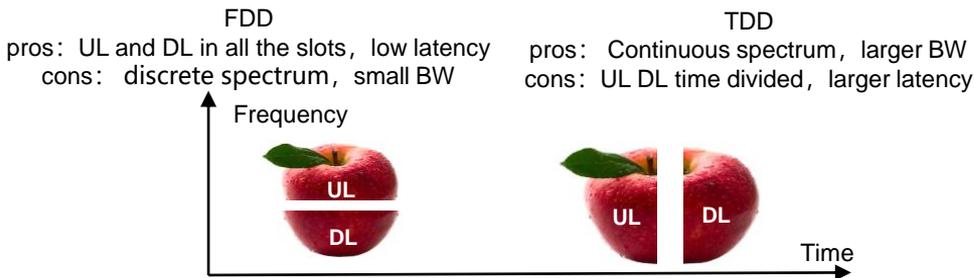


Objective

- » Study and specify multi-cell PUSCH/PDSCH scheduling DCI **containing 2 stages.**

Motivation

- » With the trend of higher frequency spectrum usage to exploit the large bandwidth and high data rates in high frequency band, it is essential for **better utilization of TDD spectrum**.
- » There are pros and cons for different duplex modes
- » **Configuring complementary UL-DL direction across different cells** makes the TDD carrier have “0” waiting time latency like FDD for both UL and DL.



Low delay + high reliability + large capacity

- » Rel-18 NR duplex enhancement at least study SBFD operation within a single TDD carrier, and there was little discussion on different TDD UL-DL configurations across cells.

Objective

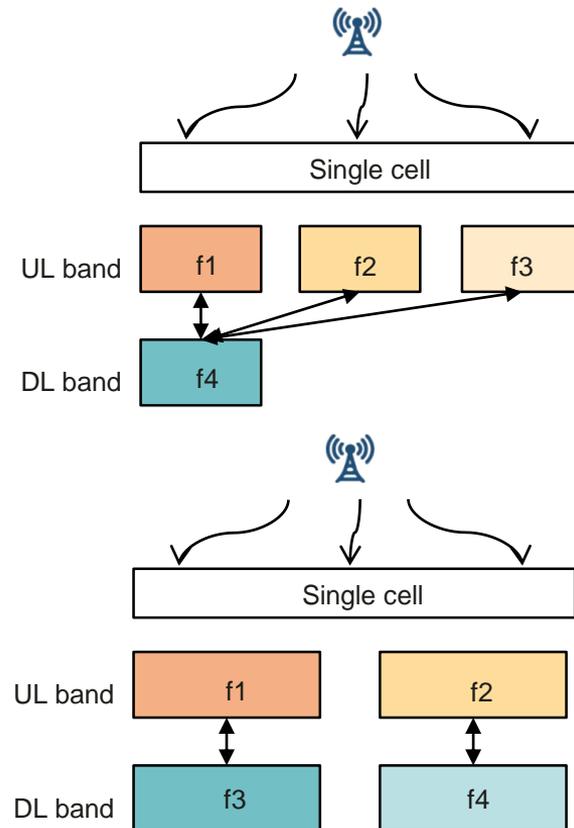
- » Enhancement for the support of complementary UL-DL configurations across cells
 - The carriers for cells having complementary UL-DL configurations are inter-band/intra-band
 - **Flexible cross cell resource utilization** (e.g. cross cell hopping, cross cell HARQ retransmission, enhancement for flexible cross cell scheduling), Interference management (intra-band), collision handling (same UL-DL direction within a symbol for a UE in intra-band case)

■ Motivation

- » The total bandwidth of FDD spectrum at lower frequencies is large, but the distribution is discrete and the bandwidth of each carrier is small.
- » For flexible and efficient usage of discrete spectrums, aggregating multiple carriers in one cell can have same operational efficiency as a network with contiguous wide-band BW, which benefits from throughput improvement and power saving.
 - **Instantaneously switched spectrum utilization** of different carriers without Scell (de-) activation procedure;
 - **No reducing of the aggregated wide BW and reduced handover** during mobility since no Scell releasing/adding procedure performed;
 - **Overhead reduction** for shared common messages and measurement information;
 - **Load balance of random access** across carriers;
 - Enable larger bandwidth utilization and higher throughput for **non-CA capable UEs**;
 - **Simplified network deployment** of multiple bands

■ Objective

- » Study and specify **multi-carrier single cell operation** with non-contiguous BW of one or multiple bands mapped to single cell
 - Enhancement of idle/inactive state (initial access, mobility mechanism) and connected state operation (fast carrier switching with multiple UL/DL BWP operation) for multi-carrier mapped to the single cell
 - More than two UL carriers associated with one DL carrier of a cell, and multiple UL and DL carriers mapped to single cell can be considered



- The following aspects are proposed for Rel-19 multi-carrier enhancements
 - » Enhancement for multi-cell PUSCH/PDSCH scheduling with a single DCI
 - Different SCS among co-scheduled cells
 - One aggregated TB mapped on co-scheduled cells
 - Multi-cell PUSCH/PDSCH scheduling with 2 stage DCI
 - » Enhancement for the support of complementary UL-DL configurations across cells
 - » Multi-carrier single cell operation

Thanks!
