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RWS-210026

3GPP TSG RAN Rel-18 workshop
Electronic Meeting, June 28 - July 2, 2021
Agenda Item: 4.3

On NR Full Duplex

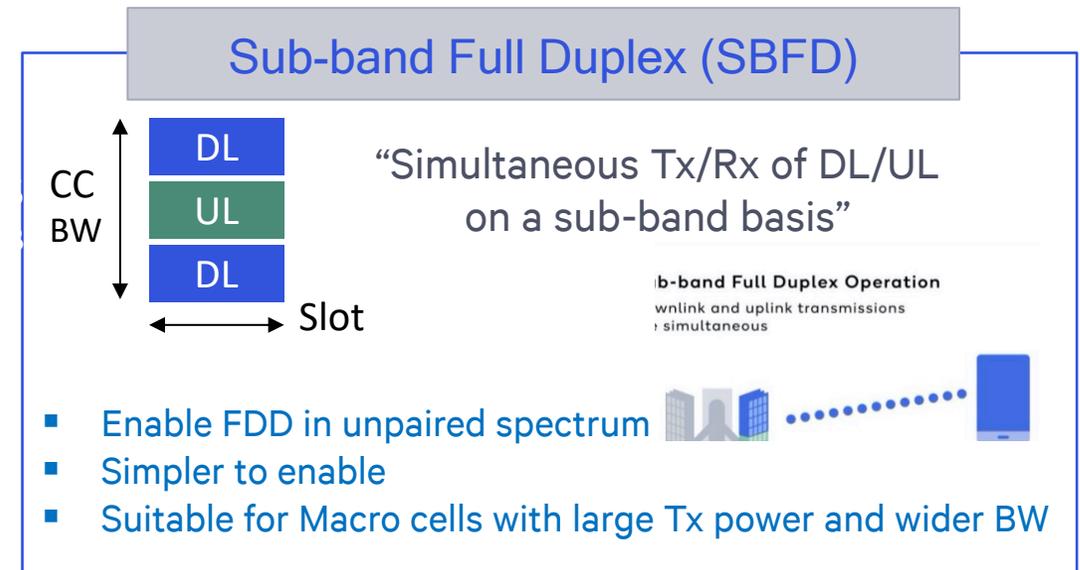
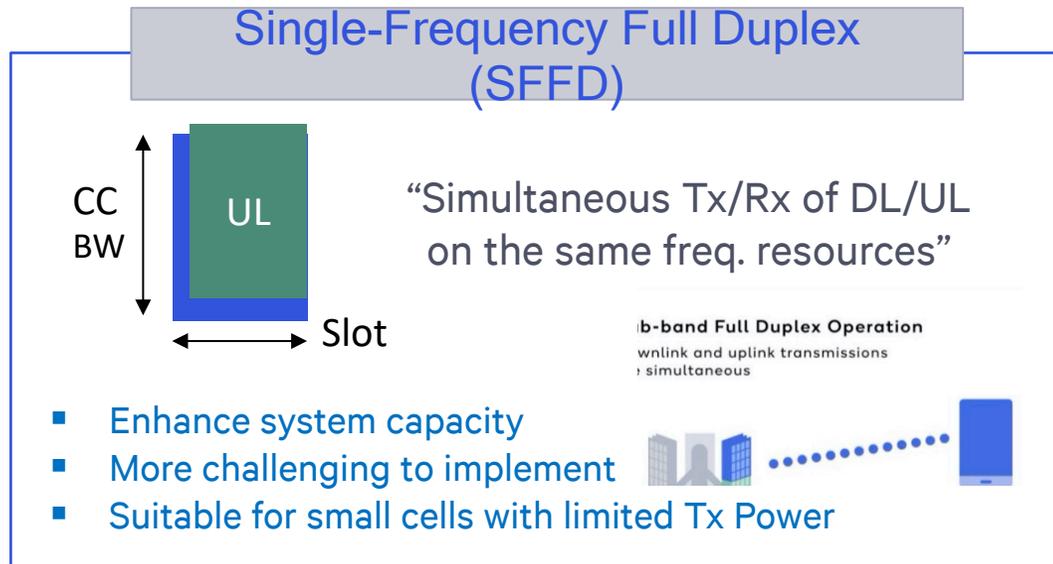
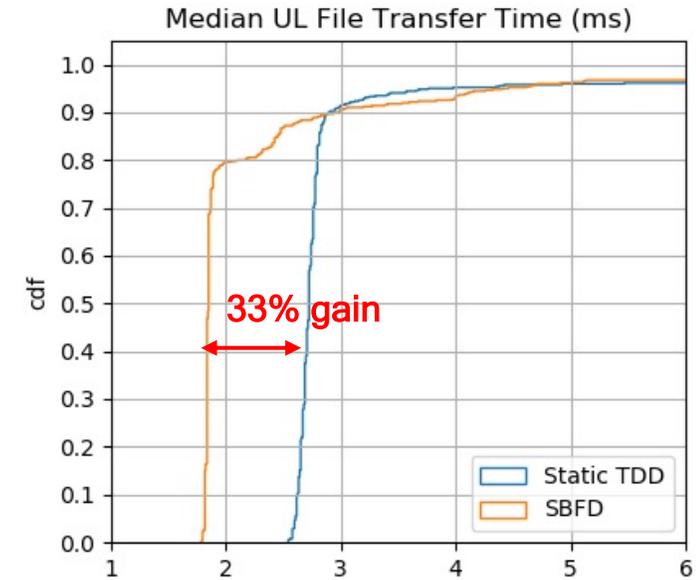
Perspectives for Release 18

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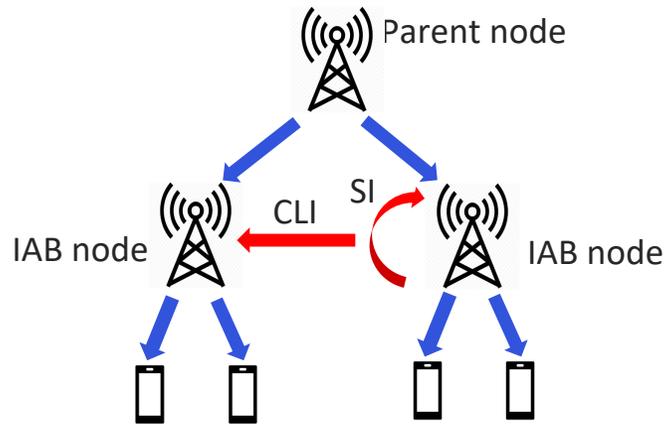
Motivation

- Introducing Full Duplex to NR in TDD bands helps:
 - Enhance system capacity
 - Latency improvement for access and IAB links
 - UL coverage improvement
 - Enable flexible and dynamic UL/DL resource adaption according to UL/DL traffic in a robust manner
 - Solutions to basic dynamic TDD challenges

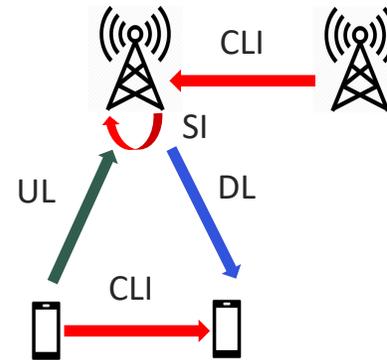


Use cases

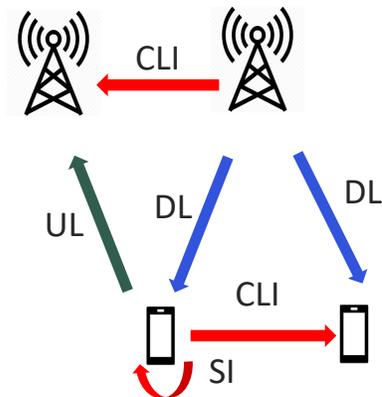
Scenario 0: FD IAB node (discussed in R17 WI)



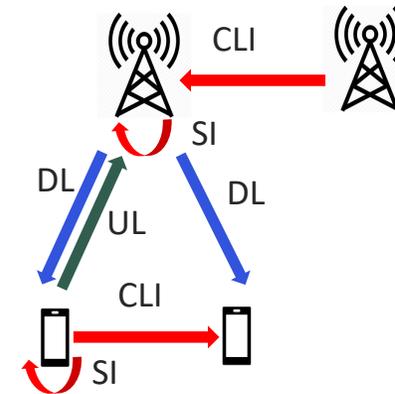
Scenario 1: FD gNB & HD UEs



Scenario 2: HD gNB (e.g. M-TRP) & FD UE/CPE



Scenario 3: FD gNB & UEs/CPEs



Full Duplex evolution and Deployment scenarios

3GPP Study Item

Objectives

- Study feasibility and enhancement, if needed, of full duplex deployment for gNB and UE across TDD bands (e.g., FR1, FR2, FR2x) [RAN1]
 - Define deployment scenarios
 - Define frequency bands and use cases
 - Study feasibility for full duplex gNB & UE (e.g., Spatial antennal/panels isolation, frequency isolation, beam isolation, interference mitigation/cancellation, etc.) [RAN1, RAN4)]
 - RAN1 study general objectives, while RAN4 confirm the feasibility.
 - Study enhancement, if needed, for cross link and self interference management in frequency and spatial domains
 - Intra-/inter- UE interference in both intra- and inter- cell scenarios
 - Intra-/inter- gNB interference
 - UL and DL frequency resources duplexing modes within TDD band:
 - FDM of UL/DL resources (SBFD)
 - SDM of UL/DL resources (SFFD)
- Enhancement of full duplex for gNB and UE can be considered for IAB [RAN1]
 - Study enhancement, if needed, of full duplex deployment for IAB in addition to R17 enhancements

Key Enablers for Full duplex gNB

1. Spatial isolation, a.k.a., “spatial duplexer” (Y dB)

- Two separate panels for simultaneous Tx/Rx.
- 80-90 dB isolation between 2 panels based on Lab measurement in FR2

2A. Frequency isolation (for SBFD)

- Subband ‘Frequency’ multiplexing UL/DL (FDM)
→ X dB isolation ($X > 40$ dB)

2B. Beam isolation (for SFFD)

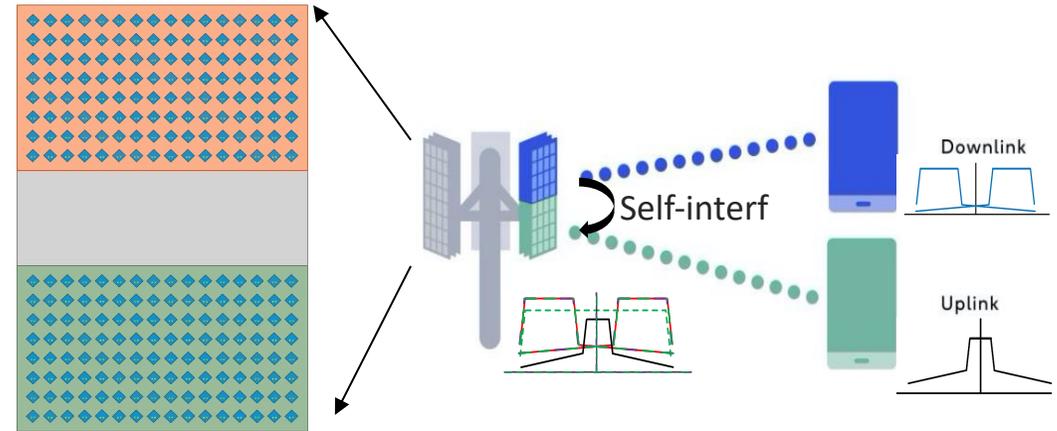
- Spatially isolated Tx/Rx beams

4. Digital/analog self interference mitigation ($\geq Z$ dB)

- Tx/Rx processing (inc. potential nulling)

Objective: Define suitable values for X,Y and Z to enable $RoT < xx$ dB for given Tx Power level

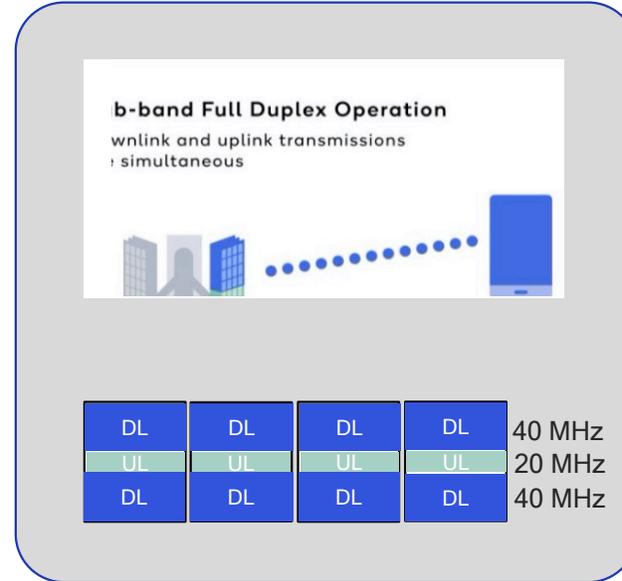
Note: For full duplex UE, RAN1 to study how to apply above techniques to enable SBFD and/or IBFD operation.



Initial Evaluation Results

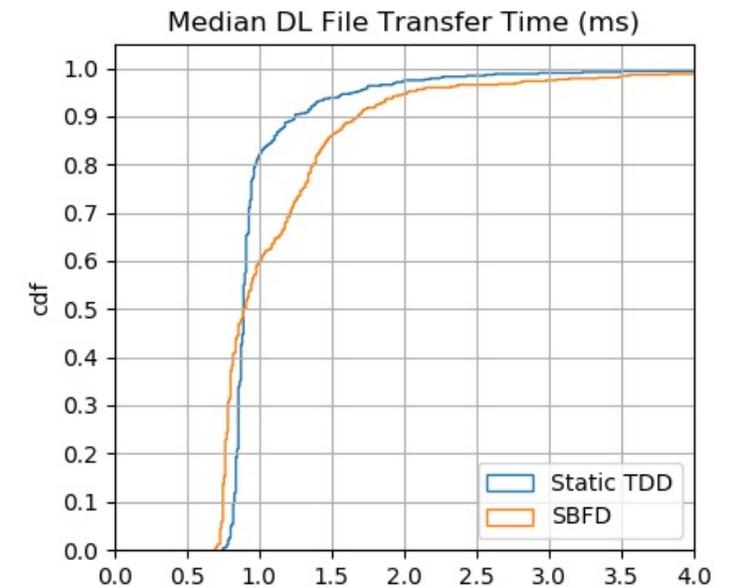
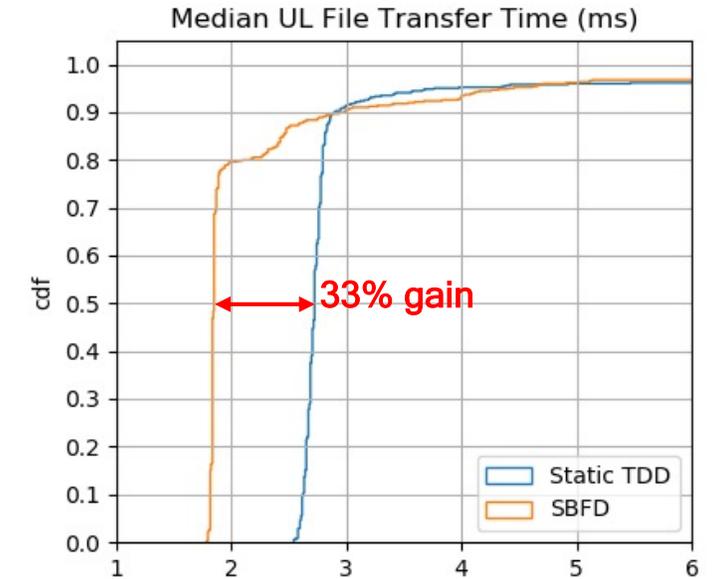
System level simulation assumption

- FR1, 21 cells, 5 DL and 5 UL UEs/cell
- SBFD (see the figure)
 - 90 dB of Panel isolation + Digital mitigation
- Traffic model
 - DL: 100 files/sec/UE - 20KB/file (16 Mbps)
 - UL: 300 files/sec/UE - 1KB/file (2.4 Mbps)



Observation

- Substantial UL latency performance (or file transfer time) improvement thanks to 100% UL duty cycle (i.e., no blocking)
- Some tail performance loss in DL due to reduced DL BW and half panel size



R17 Status: Full Duplex for IAB

- In R17, the support of simultaneous operation between IAB node's child and parent links has been agreed in IAB WID
 - Simultaneous operation includes Tx+Rx, i.e. full duplex, which can improve spectral efficiency & latency at the IAB node
- RP-193251
 - Duplexing enhancements [RAN1-led, RAN2, RAN3, RAN4]:
 - Specification of enhancements to the resource multiplexing between child and parent links of an IAB node, including:
 - Support of simultaneous operation (transmission and/or reception) of IAB-node's child and parent links (i.e., MT Tx/DU Tx, MT Tx/DU Rx, MT Rx/DU Tx, MT Rx/DU Rx).
 - Support for dual-connectivity scenarios defined by RAN2/RAN3 in the context of topology redundancy for improved robustness and load balancing.
 - Specification of IAB-node timing mode(s), extensions for DL/UL power control, and CLI and interference measurements of BH links, as needed, to support simultaneous operation (transmission and/or reception) by IAB-node's child and parent links.



Thank you

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