3GPP TSG RAN #101
Bangalore, India, September 11 - 15, 2023

RP-232074

Source: NTT DOCOMO, INC.
Agenda item: 8A.2.3
Document for : Discussion

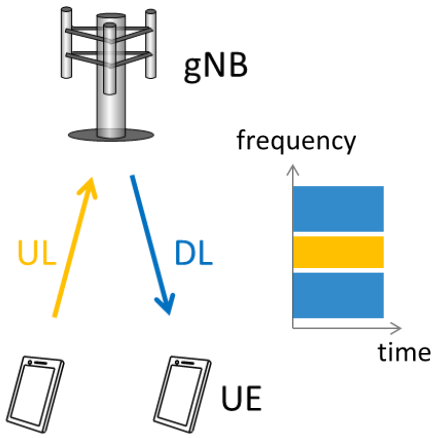
Views on Rel-19 evolution of NR duplex operation

NTT DOCOMO, INC.

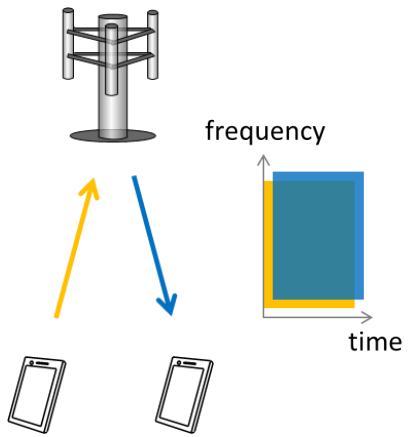
Introduction

- Full Duplex (FD) realizes efficient and flexible UL and DL resource configuration with providing following benefits, and hence it can be one of advanced features as “a bridge to 6G”
  - FD is beneficial for adaptation to DL and UL traffic fluctuation, e.g., UL heavy traffic
  - FD is beneficial for lower latency and coverage improvement by exploiting increased UL time resources

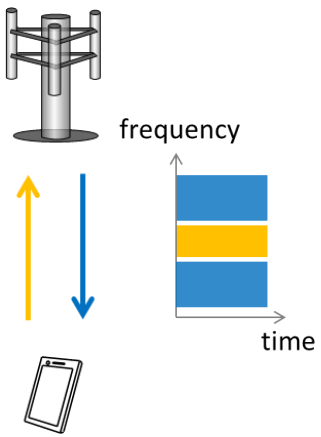
- Following options can be considered for duplex evolution, and Sub-Band non-overlapping Full Duplex (SBFD) at gNB, which is the initial step toward the realization of FD, and RAN1 study of duplex evolution including SBFD (Study on evolution of NR duplex operation) in Rel-18 is completed



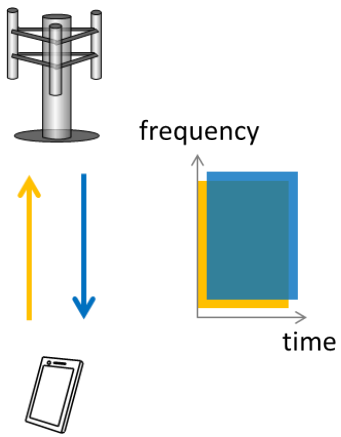
SBFD at gNB



Overlapping FD at gNB



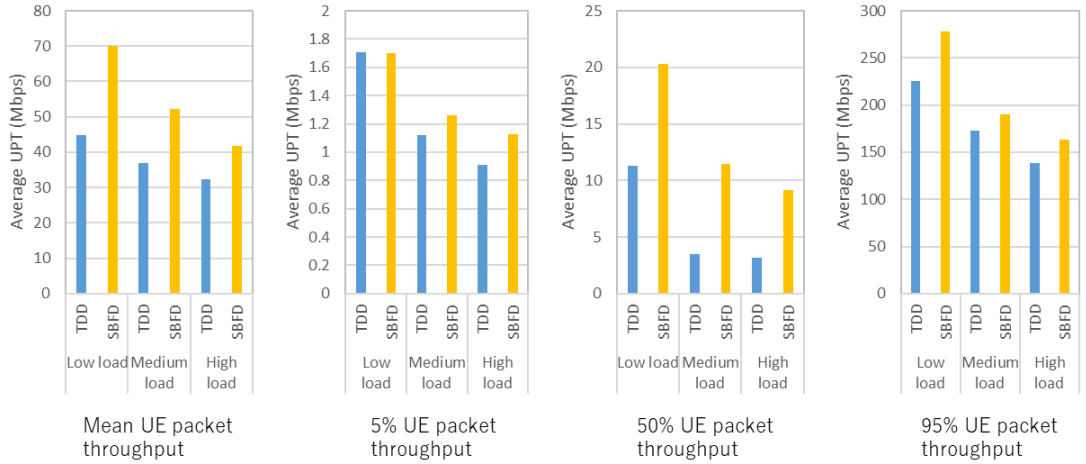
SBFD at gNB/UE



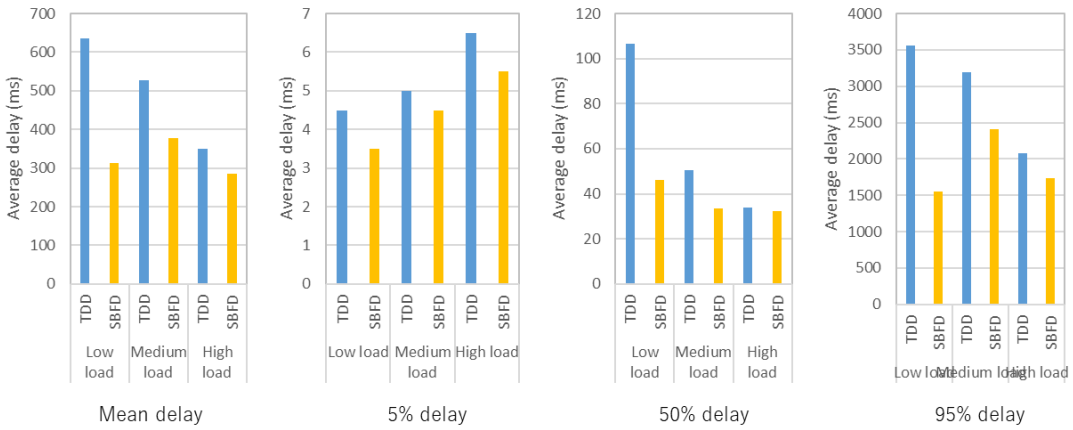
Overlapping FD at gNB/UE

Motivation for SBFD at gNB

- **Views on the outcome of Rel-18 study on semi-static SBFD at gNB:**
  - Based on the evaluation results on SBFD operation, we have identified following points.
    - » Interference modeling/handling (e.g., self-interference, inter-sector CLI, inter-site CLI and UE-to-UE CLI) and corresponding performance are essential factors to determine the target scenario/use case of SBFD operation
      - – In certain conditions (e.g., Indoor scenario, low traffic load and large inter-sector isolation), performance gain from SBFD operation can be observed as follows:
        - ✓ Performance gain of UL/DL comes from more UL/DL transmission opportunities compared to TDD
        - ✓ Performance gain of UL is further increased by increasing UL resources instead of DL resources
- **We have observed benefits of SBFD operation based on Rel-18 study, and hence we propose to start the normative work on SBFD at gNB including enhancements for interference handling in Rel-19**



(a) UL UE packet throughput



(b) UL delay

Examples of SLS evaluation results in FR1 Urban macro

Proposed objectives for SBFD at gNB

- Following topics are our proposed objectives for SBFD operation at gNB
  - **Introduction of SBFD operation at gNB [RAN1]**
    - » Indication of time and frequency domain locations of SBFD subbands to UEs
      - – Semi-static configuration of SBFD subband time and frequency locations in SIB.
      - – [Dynamic SBFD is not supported]
    - » UE transmission, reception and measurement behavior and procedures in SBFD symbols and/or non-SBFD symbols
      - – Potential enhancements for physical channel/signal and procedure, including PDCCH/PDSCH/CSI-RS/PUCCH/PUSCH/SRS/CSI reporting
      - – DL and UL collision handling in SBFD symbol
      - – Collision handling for DL/UL collision in SBFD symbol
      - – CFRA in SBFD symbol
  - **Enhancements of interference handling for SBFD operation [RAN1, RAN3]**
    - » Inter-UE CLI handling schemes specific to SBFD operation
      - – Potential enhancements for UE-to-UE CLI-RSSI measurement resource and/or reporting, e.g., non-contiguous CLI-RSSI measurement across two DL subbands, finer granularity for CLI-RSS reporting
      - – [UE-to-UE RSRP/RSSI measurement within UL subband is not supported]
  - **gNB RF requirement for SBFD operation [RAN4]**
    - » Define gNB RF requirement for SBFD operation

Motivation and proposed objectives for CLI handling enhancements

- Based on the outcome of Rel-18 study on evolution of duplex operation in TR 38.858, we believe that introduction of gNB-to-gNB CLI measurement/reporting and enhancements of UE-to-UE CLI measurement/reporting are beneficial for CLI handling

- Following topics are our proposed objectives for CLI handling enhancements

Introduction of gNB-to-gNB CLI measurement/reporting [RAN1, RAN3]

- Information exchange among gNBs
  - » Semi-static SBFD time and frequency resource configuration
  - » Spatial domain information (e.g., DL Tx beam information of the gNB)
  - » Reference signal/channel (e.g., NZP CSI-RS, NCD-SSB) configuration

Enhancements of UE-to-UE CLI measurement/reporting [RAN1, RAN3]

- L1/L2 based CLI measurement and reporting
  - » Configurations for measurement and reporting for L1/L2 based CLI
- Beam level CLI measurement and reporting
  - » Victim UE to measure CLI with different Rx beams for different Tx beams from aggressor UE

Summary of proposals

- **Proposed scope of the normative work on evolution of NR duplex operation**
  - **Rel-19 : Scope of WI: evolution of NR duplex operation**
    - » Introduction of SBFD operation at gNB [RAN1]
      - – Indication of time and frequency domain locations of SBFD subbands to UEs
      - – UE transmission, reception and measurement behavior and procedures in SBFD symbols and/or non-SBFD symbols
    - » Enhancements of interference handling [RAN1, RAN3]
      - – Introduction of gNB-to-gNB CLI measurement and reporting
        - ✓ Information exchange among gNBs
      - – Enhancements of UE-to-UE CLI measurement and reporting
        - ✓ Inter-UE CLI handling schemes specific to SBFD operation
        - ✓ L1/L2 CLI measurement and reporting
        - ✓ Beam level CLI measurement and reporting
    - » gNB RF requirement for SBFD operation [RAN4]
      - – Define gNB RF requirement for SBFD operation

Views on other potential proposals

- [Dynamic SBFD]
  - Dynamic SBFD may increase gNB implementation complexity, may incur loss of resources due to transition time, may increase inter-gNB CLI as well as inter-UE CLI, may increase scheduling complexity, and can result in additional specification impact on top of semi-static SBFD.
  - If dynamic/flexible adaptation of DL/UL resources based on DL/UL traffic is necessary, dynamic TDD can be applied.
- [SBFD during initial access]
  - If resources to be used during initial access are used as SBFD symbols, the initial access related procedures would suffer from CLI, and CLI caused by UL transmission during initial access may be large as it would be out of gNB's control.
- [UE-to-UE CLI (RSRP/RSSI) measurement within UL subband]
  - CLI measurement within UL subband may lead to increased UE complexity and additional specification impact, while the actual UE-to-UE CLI happens in DL resource rather than UL subband, i.e., it may not be so beneficial.
- [SBFD at UE]
  - Even in non-overlapping DL reception and UL transmission, the self-interference would be challenging considering UE complexity and limited space for isolation.
  - There may be no strong benefit of UE side SBFD {SBFD at gNB, SBFD at UE} compared to UE half duplex {SBFD at gNB, HD at UE} , due to the self-interference at UE.

NTT docomo