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

RP-232578

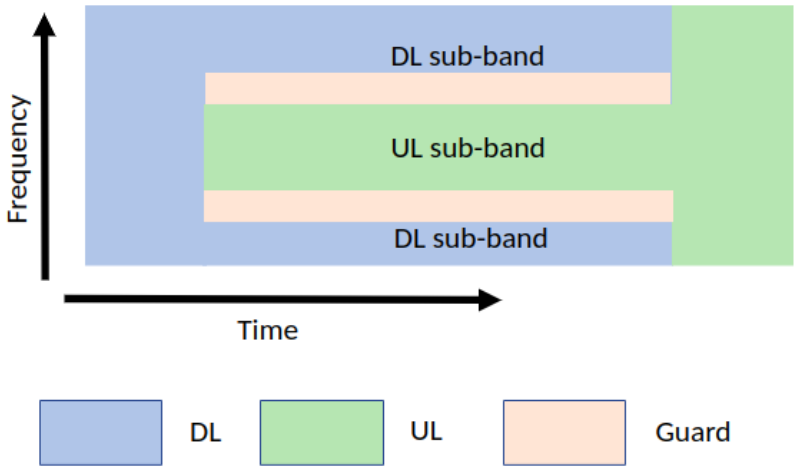
NR Duplex Evolution

Agenda item: 8A.2.3

Sourced by: **CEWiT, IIT-K, IIT-H**, IIT-M

Background

- gNB simultaneously transmits and receives in frequency sub-bands within a TDD carrier
- Rel. 18 SI on duplexing enhancements for RAN1 got completed in August 2023
  - Evaluation on NR Duplex operation
  - Sub-band non-overlapping full duplexing (SBFD)
  - Potential enhancements on dynamic/flexible TDD
    - gNB-gNB cross link interference
    - UE-UE cross link interference



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Motivation

- Rel. 18 study concluded the following about SBFD enhancements
  - UL coverage gain using SBFD [1]

Agreement RAN1#114

Based on link level simulation, comparing SBFD with XXXXU slot format and legacy TDD with DDDSU slot format, RAN1 observed, with assumption of 1dB desense for self-interference suppression and different co-site inter-sector isolation values,

- semi-static SBFD with PUSCH repetition type A without/with joint channel estimation provides the UL coverage gain in range of {0.00~6.75}dB and median value of 5.41dB from 13 sources in FR1 UMa and {5.86~8.76}dB and median value of 6.92dB from 4 sources in FR2-1 Dense UMa , respectively.
- semi-static SBFD with TBoMS with/without joint channel estimation provides the UL coverage gain in range of {2.83~6.88}dB and median value of 5.09dB from 4 sources in FR1 UMa and {4.49~7.82}dB and median value of 5.72dB from 2 sources in FR2-1 Dense UMa, respectively.

  - UL and DL UPT gain using SBFD [1]

Conclusion RAN1#114

In case of using SBFD with XXXXX slot format, the UL UPT gain at least comes from more UL transmission opportunities for semi-static SBFD compared to legacy TDD, and the DL UPT gain at least comes from the more DL transmission opportunities for semi-static SBFD compared to legacy TDD.

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Motivation cont'd

- Feasibility, specification impact and co-existence with legacy [1]

Agreement RAN1#114

The following conclusion is to be captured in the TR 38.858 section 13:

SBFD operation at gNB for UEs was studied under the following assumptions,

- SBFD operation within a TDD carrier,
- SBFD scheme within a single configured DL and UL BWP pair with aligned center frequencies, and
- Up to one UL subband for SBFD operation in an SBFD symbol (excluding legacy UL symbol) within a TDD carrier.

RAN1 concluded SBFD operation Alt 4 is feasible for RRC_CONNECTED state from the RAN1 specification perspective, where SBFD operation Alt 4 assumes

- Both time and frequency locations of subbands for SBFD operation are known to SBFD aware UEs.
- UE behaviors for non-SBFD aware UEs follow existing specifications.
- From RAN1 perspective, new UE behaviors can be introduced for SBFD aware UEs based on the time and frequency locations of subbands for SBFD operation.

Non-SBFD aware UEs, including legacy UEs, and SBFD aware UEs can coexist in cells with SBFD operation at gNB side from RAN1 specification point of view.

To support SBFD operation Alt 4 for RRC_CONNECTED state, RAN1 identified the following potential specification impact for SBFD-aware UE:

- 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

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Motivation cont'd…

- Rel. 18 concluded the following about dynamic TDD enhancements [1]

  Agreement RAN1#114

  The following conclusion is to be captured in the TR 38.858 section 13:

  For dynamic/flexible TDD, the gNB-to-gNB co-channel CLI handling schemes and UE-to-UE co-channel CLI handling schemes, which can be specific for dynamic/flexible TDD and/or common for both SBFD and dynamic/flexible TDD, were studied, including analysis, performance and specification impact, which are included in Section 8.3 and Section 8.4. The summary of observations for gNB-to-gNB CLI handling schemes are included in Section 8.3.

- Major drawbacks of Rel. 16 cross link interference (CLI) management
  - gNB-gNB CLI management was left up to implementation
  - No support for SRS configuration exchange among gNBs for UE-UE CLI management

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Motivation cont'd…

- Following observation is captured in the draft version of TR 38.858

8.4.1 UE-to-UE co-channel CLI measurement and reporting

8.4.1.1 Description

RAN1 studies the feasibility and potential benefit of UE-to-UE co-channel CLI measurement and reporting, which can be specific for dynamic/flexible TDD and/or common for both SBFD and dynamic/flexible TDD. At least followings are included:

- Measurement resource/reporting configuration
- Measurement/reporting details (including UE processing delay)
- Relevant information exchange (between gNBs) if needed
- Usage of measurement at gNB

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Proposal

- A WI with the following objectives is proposed for Rel. 19 based on the conclusion in Rel. 18 SI
  - SBFD
    - Signaling configurations for SBFD operation
    - UE behavior based on configurations for SBFD operation
    - Physical signals/channel mapped to SBFD and non-SBFD symbols within/across slots
    - CSI-RS measurement and reporting
    - Transmission of SSB and SSB measurement
  - Dynamic TDD
    - UE-UE CLI handling
      - L1/L2 based CLI measurement and reporting
      - SRS configuration information exchange among gNBs
      - Spatial domain enhancements for CLI measurement and reporting
      - Enhancements related to CLI measurement accuracy
    - gNB-gNB CLI handling
      - Non-transparent UL resource muting for CLI measurement

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References

- Chair's Notes, RAN1 #114, August 2023

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Thank you