3GPP RAN Rel-19 Workshop RWS-230170

June 15th-16th, 2023, Taipei, Taiwan

Agenda Item: 5

NR Duplex Evolution

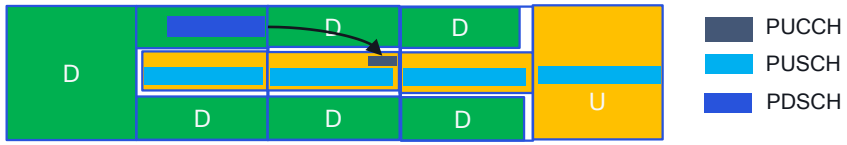
Qualcomm Incorporated

Outline

- Motivation
- WI scope for gNB SBFD operation
- WI scope for potential enhancement on dynamic TDD

Motivation for SBFD operation at gNB

Motivation and Scope of WI



- Motivation for SBFD operation at the gNB
  - Improve UL coverage by enabling continuous UL transmission in UL-subband across SBFD slots.
  - Reduce UL latency by having UL opportunity in almost every slot and improve A/N feedback duty cycle.
- Non-transparent SBFD operation by indicating to the UE the gNB UL/DL subband configurations enables:
  - Enhancement for the resource allocation and transmission/reception parameters (e.g., power control)
  - SBFD-aware UE can utilize the SB knowledge to enhance the receiver filters to reduce impact of inter-UE cross-link interference (CLI) and/or achieve further power savings benefits
- Promising outcome so far based on companies' evaluation results and RAN1/RAN4 observations
  - SLS/LLS evaluation results showing SBFD gain in terms of UL coverage (4-5 dB) and improved UL latency/ UPT for UMa scenario [1].
  - RAN1: SBFD at Indoor office achieves higher mean and 5% UL Average-UPT than legacy TDD for all load levels for both small and large packets and different loads [2].
  - RAN4: For implementation feasibility study, RAN4 confirm FR1 MR and LA SBFD gNB with 1dB sensitivity degradation due to self-interference is achievable. [3].
- Scope should focus on the scenarios discussed in Rel-18 study item, mainly SBFD operation within a TDD carrier based on semi-static SBFD operation for RRC-connected UE as baseline.

[1] R1-2305334, “On deployment scenarios and evaluation methodology for NR duplex evolution, Qualcomm”, 3GPP RAN1#113, May 22nd – May 26th, 2023.

[2] RAN1 Chair’s Notes,” RAN1#113, May 22nd – 26th , 2023.

[3] RAN4 BS RF Chair’s Notes,” RAN4#107, May 22nd – 26th , 2023.

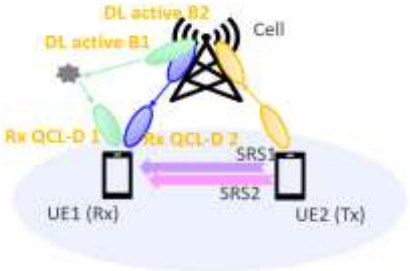
Motivation for Dynamic TDD enhancement

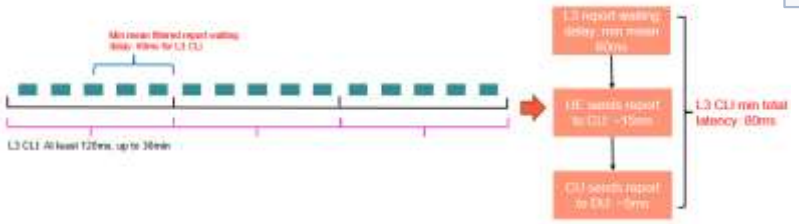
Common enhancement with SBFD only

- Enhancement for inter-UE CLI
  - RAN1 concluded on benefits on L1/L2 CLI measurement and reporting [1]

Conclusion

- The L1/L2 based UE-to-UE CLI measurement can be optimized for short term interference measurement
- The L1/L2 based UE-to-UE CLI measurement can be optimized for low latency
- The L1/L2 based UE-to-UE CLI measurement and reporting can facilitate gNB adjusting UE scheduling for inter-UE CLI reduction





- Enhancement for inter-gNB CLI
  - RAN1 concluded on benefits for inter-gNB CLI measurement and/or channel measurements.

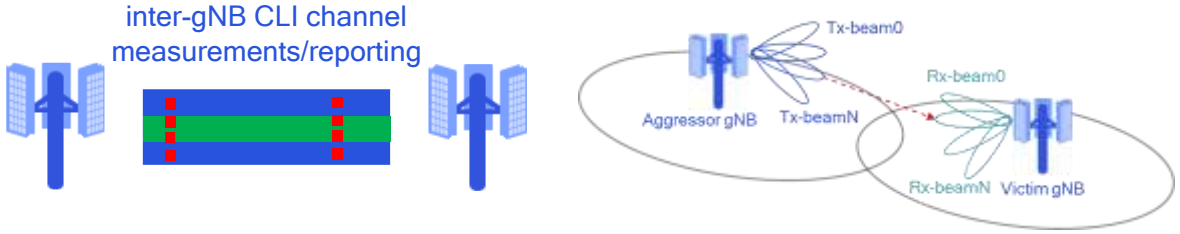
The following conclusion is to be captured in the TR

In the study of gNB-to-gNB co-channel CLI measurement and/or channel measurement, it is assumed that periodic NZP CSI-RS/SSB is the baseline. Also, for the study, it is assumed that both CD-SSB and NCD-SSB can be used for gNB-to-gNB CLI measurement. From the study of gNB-to-gNB co-channel CLI measurement and/or channel measurement, followings are observed:

- …
- SSB resources may be useful for coarse tracking of CLI levels
- NZP CSI-RS resource configurations provided to neighbor gNBs can be used for the purpose of estimating inter-gNB CLI levels.
- NZP CSI-RS resource configurations provided to neighbor gNBs also can be used for the purpose of estimating inter-gNB channel which helps Tx / Rx gNBs perform beamforming to reduce inter-gNB CLI.

Agreement:

For spatial domain coordination, the exchange of beam related information among gNB(s) (e.g., victim gNB(s) and aggressor gNB(s)) can be an enabler for inter-gNB co-channel CLI management.



[1] "RAN1 Chair's Notes," RAN1#113, May 22nd – 26th , 2023.

WI scope for Duplexing evolution (1/2)

SBFD WI scope

- Objective of SBFD WI [RAN1, RAN2, RAN4]
  - Within a TDD carrier, specify UL/DL subbands time and frequency configuration/indication to at least UE in RRC-connected mode [RAN1, RAN2]
  - SBFD-aware UE behavior/operation in SBFD symbols (D/F symbol with configured UL subband) [RAN1]
  - SBFD collision handling and priority rules between conflicting UL and DL, including SSB [RAN1]
  - Enhancement for resource allocation and transmission/reception parameters of UL/DL signals and channels for SBFD-aware UE [RAN1]
  - SBFD-specific inter-UE and inter-gNB CLI enhancement [RAN1]
  - Specify potential enhancement for extension of SBFD operation across component carriers [RAN1]
  - Specify BS OTA and conducted RF requirements for SBFD operation [RAN4]
  - Impact on UE RF requirements based on the outcome of study item [RAN4]

WI scope for Duplexing evolution (2/2)

Potential enhancement on Dynamic/Flexible TDD [RAN1, RAN3, RAN4]

- The WI scope for dynamic/flexible TDD should only include common enhancement with SBFD
  - Inter-UE CLI handling schemes should be higher priority.
- Potential enhancement on dynamic/flexible TDD [RAN1, RAN3, RAN4]
  - Enhancement for Inter-UE co-channel CLI [RAN1, RAN2]
    - L1/L2 inter-UE CLI measurements and reporting using the CSI framework as baseline.
    - QCL TypeD indication for CLI measurement.
    - Finer frequency granularity (e.g. subband) for CLI measurements and reporting.
  - Enhancement for inter-gNB co-channel CLI [RAN1, RAN2, RAN3]
    - CLI measurement and/or channel measurement including related inter-gNB info exchange
    - Spatial domain coordination including beam-related info exchange
    - Power domain enhancement: separate uplink power control parameters for symbols with and without CLI, and downlink transmission power adjustment including related inter-gNB info exchange.
    - Time and frequency resource coordination between the gNBs including semi-static SBFD configuration exchange.

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