

# Evolution of NR Duplex Operation in Rel-19

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Agenda Item: 5

Source: Nokia, Nokia Shanghai Bell

The Nokia logo is displayed in white, uppercase letters within a dark blue circular area. This area is part of a larger graphic consisting of two concentric white circles on a green-to-blue gradient background.

# Evolution of NR Duplex Operation

## Motivation

The Rel-18 study is still ongoing, without conclusions on the feasibility of Sub Band Full Duplex (SBFD), performance gains of SBFD and enhancements to dynamic TDD. Conclusions indicate that SBFD will require new/enhanced implementation at the gNB.

Our preliminary analysis show that:

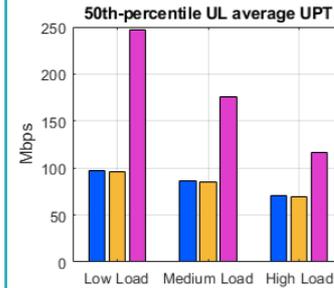
- When considering realistic assumptions, wide area SBFD deployments are unfeasible due to high inter-sector interference and inter-site gNB-gNB interference
- Local area SBFD deployments are feasible and SBFD reduces latency when compared to static TDD. In some scenarios, though, the throughput is comparable to dynamic TDD.
- We also note that enhanced UL performance can be obtained by solutions already supported in the specification

Dynamic TDD is less complex than SBFD, does not require new gNB hardware and has similar performance in local area deployments. Dynamic TDD enhancements studied in Rel-18 can be standardized in Rel-19 and can be used as enablers for SBFD in the future.

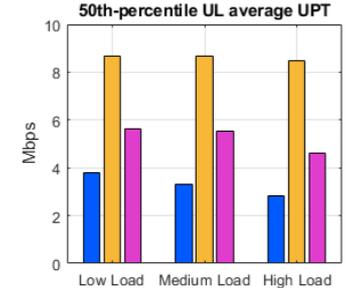
SBFD performance and how to make SBFD operations more efficient with UE RF enhancements have not yet been studied in Rel-18. Performance and feasibility of UE RF enhancements are important to understand prior to 6G studies.

### Local Area BS\*

#### Large Payload



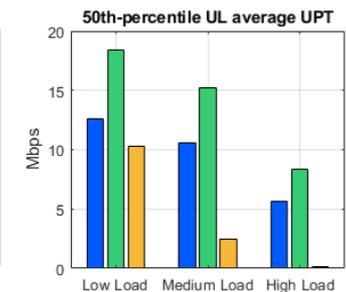
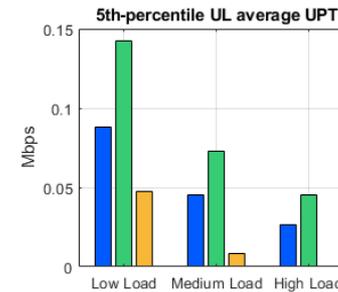
#### Small Payload



Static TDD 23 dBm SBFD SameGain 23 dBm Dynamic TDD 23 dBm

\*TDD: {DDDSU}, SBFD: {XXXXX}

### Wide Area BS\* – Large payload



Static TDD 23 dBm Static TDD 26 dBm SBFD SameGain optimistic 23 dBm

\*TDD: {DDDSU}, SBFD: {XXXXX}, optimistic inter-sector isolation PC2, max. Tx power = 26 dBm when UL duty cycle is less than 50%

# Evolution of NR Duplex Operation

## Normative work in Rel-19

Based on the Rel-18 feasibility studies made so far, we see that normative work for NR Duplex operations could proceed with the following objectives:

### gNB-gNB cross-link interference (CLI)

- Specify mechanisms to support cross-link interference measurements and reporting at a gNB:
  - Efficient resource configuration, accurate measurements and flexible reporting
- Specify gNB-gNB CLI mitigation techniques for dynamic TDD based on:
  - gNB-gNB channel estimation and pre-coding matrix adaptation, analog beam coordination
  - Enhancements on existing power control mechanism both to open-loop and close-loop
  - Scheduling coordination between aggressor and victim gNBs for CLI avoidance
  - Advanced-gNB receivers for effective cross-link interference suppression

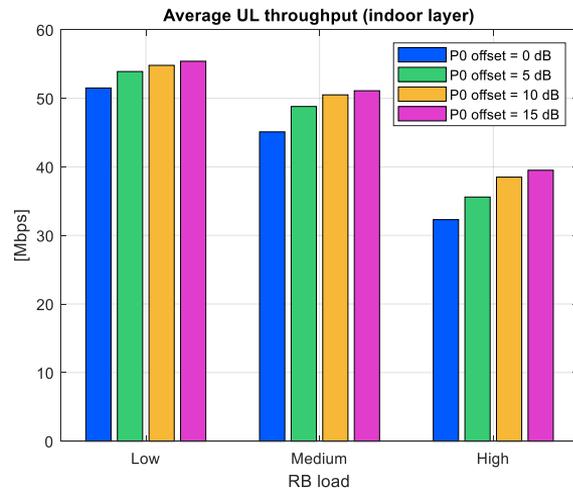
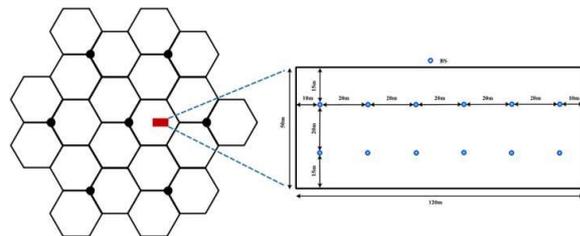
### UE-UE cross-link interference

- Specify L1/L2 measurements and reporting:
  - CSI enhancements: measurement resource configuration, reporting enhancements to convey CLI information
  - Sub-band reporting for more accurate understanding of the CLI at the gNB – useful for SBF
  - Flexibility on the QCL type-D assumption for UE CLI measurements
- Specify CLI mitigation techniques:
  - UE Tx power control mechanisms to handle UE-UE CLI

### Specify enhancements on the Xn interface to support the signaling of:

- gNB-gNB and UE-UE CLI measurements resource configuration and reports
- Information needed to enable the different interference coordination schemes

## Large payloads – 2-layer Scenario B



## PC optimization for gNB-gNB handling

# Evolution of NR Duplex Operation

## Further SBFD studies in Rel-19

As some of the SBFD aspects and especially UE RF enhancements for more efficient SBFD operations have not yet been studied, we see that the following further studies on SBFD would be important in Rel-19. This would enable to understand full potential of SBFD prior to 6G.

- Revisit the simulation assumptions agreed in Rel-18 for SBFD operation:
  - Challenging UL receiver sensitivity degradation due to self-interference
  - Applicability of analog sub-band filtering , especially for massive MIMO deployments
  - Adjacent-channel inter-sector isolation for co-located base stations
- Study enhancements for inter-operator coordination to enable SBFD operation in more deployments
- Study the feasibility of duplex enhancements at the UE
  - including the antenna separation/ isolation that can be expected at the UE
  - Consider clutter in the vicinity of different UE types, such as CPE and vehicle mounted UEs
- Study UE RF requirements enhancements for more efficient SBFD operations, including:
  - ACLR performance, maximum input power requirements, UE blocking robustness including the intermodulation requirements
- Study potential enhancements and the benefits of duplex enhancements at the gNB and at the UE and identify applicable scenarios
  - Study the support of different  $N_{TA\_offset}$  values per slot type, potential enhancements to measurement and measurement report, UE-UE CLI mitigation for SBFD and Spatial processing

# Evolution of NR Duplex Operation in Release 19 Proposal

# 1

Initiate Rel-19 work item on NR Duplex Operations for scenarios and assumptions, which are concluded feasible in the study items

# 2

Study further SBFD enhancements like UE RF enhancements to enable more efficient SBFD operation and to understand full potential of SBFD prior to 6G studies

NOKIA