

3GPP TSG RAN#102

RP-232869

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Agenda item: 9.1.1.3

NR Duplex Enhancements

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Duplex evolution situation in Rel-18

- ◆ As a possible enhancement to the conventional TDD operation, which has limitations on UL capacity, coverage and latency, Rel-18 considered “NR Duplex Evolution Enhancements” to allow simultaneous UL and DL within a TDD carrier. The study items included studying the subband non-overlapping full duplex (SBFD) and potential enhancements on dynamic/flexible TDD operations within the SBFD.
- ◆ The objective of the SBFD study was to identify and evaluate the potential improvements by allowing for support of SBFD for NR TDD in the unpaired spectrum. The following scope was defined:
 - Identify possible schemes and evaluate their feasibility and performances
 - Study inter-gNB and inter-UE CLI handling and identify solutions to manage them
 - Study the feasibility of and impact on RF requirements considering the self-interference, the inter-subband CLI, and the inter-operator CLI at gNB and the inter-subband CLI and inter-operator CLI at UE
- ◆ The objective of studying dynamic/flexible TDD was to explore the enhanced solutions presented in order to manage the inter-gNB and inter-UE CLI

Duplex evolution in Rel-19

- ◆ In Rel-19, the study on duplex evolution should be converted into a WID, with the following aspects considered at minimum for duplex evolution operations
 - Semi-static SBFDD operation including indication of UL subband time/frequency resource to SBFDD-aware UE
 - Enhancements for UL transmissions and DL receptions across SBFDD symbols and non-SBFDD symbols, including
 - PDSCH/PUSCH/PUCCH repetitions
 - SPS PDSCH/CG PUSCH
 - TBoMS
 - Multi-PUSCH/PDSCH scheduled by a single DCI
 - Periodic/semi-persistent SRS/CSI-RS/PUCCH
 - PDCCH
 - Frequency resource allocation enhancements in SBFDD symbols for UL/DL channels
 - Consider impact on CSI measurements/reporting due to DL subband measurements and SBFDD antenna configuration, including
 - CSI resource/report configuration
 - Frequency resource allocation of CSI-RS resources
 - Enhancements to CSI reporting
 - UE collision handling for UL and DL in the SBFDD symbol
 - Inter-gNB and inter-UE CLI mitigation schemes including exchange of SBFDD configuration between gNBs

Duplex evolution in Rel-19

- Additionally, the following aspects should be considered in the scope of WID for enhanced SBF D performance
 - **Dynamic SBF D operation**
 - **Random Access Procedure for SBF D symbols**
 - **SBF D operation in the RRC_inactive state**

Support of Dynamic SBFD

- ◆ While semi-static SBFD may provide improvements in UL coverage and latency performance, it may be restrictive in adapting to dynamic traffic requirements
 - Next generation applications, like XR, when deployed in massive scale, can create significant and dynamic variations in UL and DL traffic which cannot always be handled in a semi-static manner. The variations in traffic flow can be even more abrupt for smaller cells; which are considered for SBFD deployment.
 - Semi-static SBFD can be used to provide high level of UL coverage but when there is sudden DL capacity requirement that cannot be filled, dynamic SBFD can be utilised to convert the SBFD symbols to DL-only symbols in order to increase DL capacity
- ◆ **Support of dynamic SBFD operation for Rel-19 WI**
 - **Support conversion of SBFD symbols to DL-only symbols**
 - **Support conversion of DL-only symbols to SBFD symbols dynamically**

Support of Random Access Procedure

- ◆ During the study item phase, there was not much time to analyse the initial access random access procedure on SBFD symbols. Therefore, support of initial access RACH on SBFD may require a large amount of efforts from the standards community
- ◆ However, random access procedure can be considered in SBFD symbols which can provide the following benefits
 - Lower random access latency
 - Reduced RACH contention
 - Increased RACH coverage
 - Reduced specification impact as RACH resources will be configured and operated only for SBFD-supporting UEs
- ◆ **Support of Random Access Procedure for SBFD for Rel-19 WI**

Support of RRC Inactive SBF D Operation

- ◆ Support of RRC_inactive state SBF D operation can obtain the same benefits as the RRC_connected state, such as enhanced UL coverage, reduced latency, improved system capacity, and improved configuration flexibility
- ◆ RRC_inactive traffic, such as Instant Messaging services (WhatsApp, QQ, WeChat etc), push notifications, keep-alive traffic, traffic from wearables (periodic positioning information etc), sensors and smart meters is increasing in volume
- ◆ Cell-common signaling of the SBF D subbands in SIB can ensure the RRC_inactive UE is aware of the SBF D configuration in order to support SDT transmission
- ◆ Specified SDT transmission in RRC_inactive state served as a good reference point can be easily implemented in RRC_inactive state for UL data transmission on SBF D operation.

- ◆ **Support of RRC_inactive state SBF D operation in R19 WI**

Summary

- ◆ As the continuation from the Rel-18 SI, the work on NR Duplex operation should be built on top of the outcome of the SI. At minimum, the following scopes should be included:
 - Support of semi-static SBFDD operations including indication of UL subband time/frequency resource to SBFDD-aware UE
 - Support of enhancements for UL transmissions and DL receptions across SBFDD symbols and non-SBFDD symbols
 - Frequency resource allocation enhancements in SBFDD symbols for DL/UL channels/signals
 - Consider the impact on CSI measurements/reporting due to DL subband measurements and SBFDD antenna configuration, including
 - UE collision handling for UL and DL in the SBFDD symbol
 - Support of inter-gNB signaling of SBFDD time/frequency resources for CLI mitigation
 - Enhanced solutions to manage the inter-gNB and inter-UE CLI in dynamic/flexible TDD

- Additionally, consider the following enhancements for Rel-19 WI
 - Dynamic SBFDD operation
 - Random Access Procedure on SBFDD symbols
 - RRC inactive state SBFDD operation

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