**3GPP TSG-RAN WG4 Meeting #111 R4-2409889**

**Fukuoka City, Fukuoka, Japan, 20th – 24th May, 2024**

**Agenda item:** 10.12.3

**Source:** Samsung

**Title:** Offline meeting minutes for [111][313] NR\_duplex\_evo

**Document for:** Approval

# Introduction

The document is intended to capture the offline meeting minutes for [111][313] NR\_duplex\_evo, which have been organized on Tuesday morning and Wednesday morning.

# Topic #1: General aspects (including RAN4 aspects for SBFD system parameters)

#### Issue 1-1-1: SBFD as band specific or general feature to all TDD bands

* [Moderator] Treat SBFD as a band specific feature or a general feature to all TDD bands
  + Option 1 (CMCC/QC/CATT/ZTE): General feature to all TDD bands
    - Option 1a (CATT/QC): SBFD Add the clarification in the specification that SBFD operation is defined for FR1 TDD bands and FR2-1 bands:
      * “subband full duplex can be applied to TDD bands given in Table 5.2-1.” (example given by QC)
  + Option 2 (vivo/Nokia): Band specific feature
    - Option 2a (vivo): Introduce duplex mode ‘SBFD’ and reflect in the gNB spec.
    - Option 2b (Nokia): Focus on defining the BS RF requirements for SBFD-capable BS in n104 band.
* Moderator Recommendation:
  + Option 1, and the exact clarification as proposed in Option 1a can be further discussed in this meeting.
* Agreement:
  + SBFD is a feature which can potentially be utilized for all TDD band, under the following considerations:
    - Option 1: Declaration based method
      * The band supported for SBFD shall be declaration based
      * The channel bandwidth supported for SBFD shall be declaration based
        + The supported channel bandwidth can be impacted by the subband/guard band size discussion
    - Option 2: General principle but with consideration(s) for a specific band
      * General principle: The channel bandwidth shall be larger than X MHz
        + FFS the value of X

X can be different for high and middle TDD bands

* + - * + For a specific band, the following further restriction(s) can be considered:

Certain restriction can be provided by operator(s) for certain band

Other restrictions are not precluded.

#### Issue 1-1-3: Applicability of SBFD and non-SBFD requirements

* [Moderator] Applicability of SBFD and non-SBFD requirements is already agreed in SI, with the following conclusion captured in TR:

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| --- |
| For SBFD-capable BS, the existing RF requirements shall be applied in the OFDM symbols/slots others than SBFD symbols/slots and RF requirement impacts in the SBFD symbols/slots will be further clarified in details in the following sections.  Some requirements might need to be tested in both SBFD and non-SBFD slots even when the requirement is the same. The reason would be if it could be expected that the BS operating condition may differ between SBFD and non-SBFD slots. Whether to apply a test in both SBFD and non-SBFD slots should be discussed on a requirement by requirement basis in the conformance part of a WI. |

while the focus is on the requirement needs to be verified in both SBFD and non-SBFD slots/symbols even though RF requirement might be the same:

* + Proposal 1 (ZTE): the conformance testing are still needed for both SBFD and non-SBFD slots even though RF requirement might be same.
* Moderator Recommendation:
  + Discussion on Proposal 1. In some requirement, the testing is not needed for non-SBFD slots/symbols.
* Agreement:
  + The conformance testing is needed for both SBFD and non-SBFD slots/symbols even though RF requirement might be same.

#### Issue 1-1-6: CLI handling impact on RF requirement

* [Moderator]: The CLI handling impact on RF requirement is discussed.
  + Proposal 1 (ZTE): RAN4 define the requirement for outside of wanted carrier based on no CLI coordination as baseline.
* Moderator Recommendation:
  + Discussion on Proposal 1 firstly.
* Agreement:
  + The CLI handling impact on RF requirement:
    - Option 1: RAN4 define RF requirements for the frequency outside of wanted carrier based on no CLI handling as baseline.
    - Option 2: FFS CLI handling impact on RF requirements

#### Issue 1-2-2: How to handle guard band and subband configurations in specification

* [Moderator] How to handle guard band and subband sizes in the specification:
  + Proposal 1 (CATT/vivo): Add clarification that only DUD and DU patterns are allowed for the sub-band configuration.
  + Proposal 2 (Qualcomm): RAN4 to further study the if given subband configurations will be specified in the core spec or will be based on manufacturer declaration and its implications on the minimum guardband specification between SBFD and non-SBFD symbols/ slots.
  + Proposal 3 (Nokia): The value of guardbands, DL and UL subbands are not fixed in the specifications. RAN4 may agree one or more ‘typical’ values for which requirements are defined, while the gNB should still have the possibility to operate with a different (e.g. larger) guardband and UL and DL subband sizes.
* [Moderator] Detailed answers/solutions for the questions in Qualcomm’s Proposal 2
  + Option 1 (CATT): Not define sub-band BW and the guard band size in specification. The RB number in the test is based on the declaration.
  + Option 2: Allowed subband configurations will be specified in the core spec
    - Proposal 4 (Samsung): A new 5.3 clause with suffix B is added to capture the BS channel bandwidth for SBFD (including Transmission bandwidth configuration, guardband and subband configuration for SBFD), with the following text proposal to be considered as baseline skeleton for triggering discussion:

=================== Start of Text Proposal ===================

5.3B BS channel bandwidth for SBFD

5.3B.1 General

<To be added, for the definition of channel bandwidth, transmission bandwidth configuration, uplink and downlink subbands and guardband within one NR channel for SBFD operation>

5.3B.2 Transmission bandwidth configuration for SBFD

<To be added>

5.3B.3 Guardband and Subband configuration for SBFD

<To be added>

=================== End of Text Proposal ===================

* + - Proposal 5 (vivo): Capture a table as below one:

**Table 1. BS SBFD configurations in FR1 and FR2-1**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SBFD configuration** | ***BS channel bandwidth* (MHz)** | | | | | | | | |
| **25** | **25** | **50** | **50** | **100** | **100** | **200** | **200** | **…** |
| DL Subband 1 | 10 | 20 | 20 | 40 | 40 | 80 | 80 | 160 | … |
| UL Subband | 5 | 5 | 10 | 10 | 20 | 20 | 40 | 40 | … |
| DL subband 2 | 10 | N/A | 20 | N/A | 40 | N/A | 80 | N/A | … |

* + Option 2a: Given configurations with certain subband size and corresponding guard band size:
    - Proposal 6 (Ericsson): SBFD configurations shall be captured in Rel-19 RAN4 specification and restricted to a limited set: Limit the number of SBFD configurations to five for FR1, and three for FR2-1.
* Moderator Recommendation:
  + Discuss on Options/Proposals firstly.
* Agreement:
  + Add clarification that only DUD and DU patterns are allowed for the sub-band configuration.
  + FFS which channel bandwidth(s) or all channel bandwidths shall be defined for RF requirements
  + For a certain channel bandwidth which RAN4 agree to introduce RF requirements:
    - FFS RAN4 only define the UL/DL subbands configuration(s) for RF requirements
      * FFS which UL/DL subbands configuration(s) will be defined in RAN4
      * FFS Guard band size is declaration based and can be different for different BS classes
      * FFS the limitation on the maximum guard band
      * FFS possible range for UL/DL subband sizes
    - From RAN4 perspective, FFS restriction or no restriction to RAN1 definition for UL/DL subband sizes within the transmission configuration for this channel bandwidth, except:
      * 1RB granularity (already introduced in RAN1)

#### Issue 1-4-1: BS RF Specification structure for SBFD requirements

* Options of how to introduce BS RF new requirements for SBFD-capable BS:
  + Option 1: Creating new sub-clauses in TS 38.104 (similar as UE feature in TS38.101)
  + Option 2: Embedding the corresponding new RF requirements for SBFD in the corresponding section of TS 38.104 (similar as NB-IoT RF requirement in TS36.104)
* Moderator Recommendation:
  + RAN4 agree the below principle:
    - How to introduce BS RF new requirements for SBFD-capable BS:
      * Creating new and standalone sub-clauses in TS 38.104 for SBFD-specific existing or new gNB RF requirements
        + FFS detailed how to implement such approach in the later phase of WI.
* Agreement:
  + How to introduce BS RF new requirements for SBFD-capable BS:
    - FFS firstly the feasibility of creating new and standalone sub-clauses (e.g., with a suffix) in TS 38.104 for SBFD-specific existing or new gNB RF requirements
      * FFS detailed how to implement such approach in the later phase of WI.
    - FFS secondly the new specification for SBFD-capable BS

# Topic #2: Modification of existing requirements - TX

#### Issue 2-1-1: PSD scaling for normal and SBFD slots/symbols

* [Moderator]: The following agreements are achieved in study item, while companies are discussing the necessity of the limitation/restriction between TX PSD between normal DL symbols/slots and SBFD DL symbols/slots:

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| Since configuration (e.g. antenna, power configuration etc) between SBFD and non-SBFD symbols/slots might be different, RAN4 reached the following consensus for the BS RF requirement of BS output power for both conducted and OTA output power:  - It is allowed to have the different conducted declaration for normal DL symbols/slots and SBFD DL symbols/slots.  - It is allowed to have different EIRP/TRP declaration (for level and direction) for normal DL symbols/slots and SBFD DL symbols/slots.  - Accuracy requirement for TRP/EIRP and conducted power shall be the same for normal DL symbols/slots and SBFD DL symbols/slots. |

* + Option 1 (Samsung/ZTE): No need to introduce the requirement for the limitation/restriction between TX PSD between normal DL symbols/slots and SBFD DL symbols/slots, which should be up to implementation.
  + Option 2 (CATT): PSD of normal and SBFD slots/symbols are same.
* Moderator Recommendation:
  + Discussion on the PSD scaling first proposal here.
* Agreement:
  + PSD scaling for normal and SBFD slots/symbols:
    - No need to introduce the restriction on PSD scaling for normal and SBFD slots/symbols
    - Vendors can declare different TX power values for normal and SBFD slots/symbols

#### Issue 2-2-1: TX intermodulation requirement

* [Moderator] The following is agreed in study item:

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| For transmitter intermodulation requirement for SBFD-capable BS, it was concluded that further study is needed on the following aspects in the normative phase:  - whether the transmitter intermodulation requirement is applicable in SBFD slots/symbols.  - the applicable co-location coupling loss assumption and the applicable receiver degradation for the transmitter intermodulation requirement, if transmitter intermodulation requirement is applicable in SBFD slots/symbols |

And the following agreement achieved in the WF:

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| Issue 2-6-1: Co-location requirement and reference antenna  * Way forward:   + Continue the discussion on TX IMD requirement for SBFD, based on the existing assumption for co-location reference antenna.     - The assumption of co-location reference antenna could be revised based on the outcome from BS RF enh. WI. |

* Proposals:
  + Option 1: Revisit 30dB isolation by considering the study in SBFD study phase (related to revisiting the assumption of co-location reference antenna, related to BS RF enh. WI).
    - Proposal 1 (CATT):
      * CL value in TX IMD co-located requirement: based on CL declaration by manufacturers;
      * Requirement: existing requirement apply (6dB REFSENSE degradation);
      * RX link: RX should be active when TX IMD requirement is applicable in SBFD symbols.
    - Proposal 2 (CMCC):
      * CL value in TX IMD co-located requirement: Use the range of spatial isolation from all companies’ input in TR 38.858 for SBFD self-interference analysis and then down-select to final typical value for Tx inter-modulation requirement
      * Requirement: existing requirement apply (6dB REFSENSE degradation).
      * RX link: FFS.
  + Option 2: Following existing co-location test setup but requirement is declaration-based, and the UL sub-band is not expected to be scheduled for SBFD UL transmission during TX IM test or some degradation is allowed.
    - Proposal 3 (ZTE): for Tx intermodulation requirement, it’s also up to vendor’s declaration. If BS claim to comply with Tx intermodulation requirement, then ACLR, UEM, spurious emission and Rx sensitivity degradation should be declared together.
* Moderator Recommendation:
  + RAN4 may firstly try to confirm the following bullets is agreeable:
    - The transmitter intermodulation requirement is applicable in SBFD slots/symbols:
      * FFS the applicable co-location coupling loss assumption
      * FFS the necessity to guarantee RX performance, e.g., (1) UL subband is not expected to be scheduled, or (2) certain degradation is allowed for UL subband.
* Agreement:
  + The transmitter intermodulation requirement is applicable in SBFD slots/symbols:
    - Follow the existing requirement
    - No receiver requirement is specified.

#### Issue 2-3-1: The necessity of Co-location ACLR requirement

* Proposals:
  + Proposal 1 (CMCC): further discuss whether the co-location ACLR or equivalent requirement is needed or not.
  + Proposal 2 (Samsung): separate the discussion by considering coexisting with legacy TDD or new SBFD system in the adjacent channel:
    - If coexisting with legacy TDD system in adjacent channel, RAN4 shall apply the existing ACLR requirement for SBFD-capable BS in SBFD symbols, and confirm this requirement can already guarantee adjacent-channel co-existence for Rel-19 SBFD operation.
    - If coexisting with new SBFD system in adjacent channel, RAN4 shall further study the ACLR requirement for SBFD-capable BS in SBFD symbols.
* Moderator Recommendation:
  + Discussion on the above Proposal 1 and 2, especially for P2 is something we can agree?
* Agreement:
  + RAN4 further study the ACLR requirement by applying the existing ACLR requirement for SBFD-capable BS in SBFD symbols/slots
    - FFS the applicable deployment scenario where different ACLR requirement could be useful, whether it justify the different ACLR requirement.

# Topic #3: Modification of existing requirements - RX

#### Issue 3-4-1: Necessity for additional co-existence study for In-band blocking

#### Issue 3-4-2: Scenario/Case for additional co-existence study (if agreed)

* Detailed proposal on desired scenario/case to be simulated
  + Proposal 1 (Ericsson): The desired scenarios are Scenario 1, 3, 5, 6, 9, and the desired case is Case 3.

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| Table 11.1-1 (from TR 38.858): Adjacent channel co-existence scenarios   | Scenario | FR | Aggressor | Victim | | --- | --- | --- | --- | | 1 | FR1 | Urban Macro | Urban Macro | | 2 | FR1 | Urban Hotspot | Urban Hotspot | | 3 | FR1 | Indoor | Indoor | | 4 | FR1 | Urban Macro | Micro | | 5 | FR1 | Micro | Micro | | 6 | FR2-1 | Urban Macro | Urban Macro | | 71 | FR2-1 | Urban Hotspot | Urban Hotspot | | 8 | FR2-1 | Urban Dense | Urban Dense | | 9 | FR2-1 | Indoor | Indoor | | Note 1: This scenario has been down-selected. | | | |   Table 11.1-2 (from TR 38.858): Adjacent channel co-existence cases   | Case | Aggressor | Victim | Slot allocation  Aggressor Victim | | --- | --- | --- | --- | | 1 | SBFD | TDD DL |  | | 2 | SBFD | TDD UL |  | | 3 | TDD DL | SBFD |  | | ~~[3a]~~ | ~~[SBFD]~~ | ~~[SBFD]~~ |  | | 4 | TDD UL | SBFD |  | | Note: Case 3 and Case 4 are down-selected for Scenario 4. | | | | |

* + Proposal 2 (Nokia): For BS Rx in-band blocking requirement, further simulations can be conducted to determine the expected blocker levels due to other operators’ BSs during SBFD slots and to define the SBFD RX blocking requirement. Scenarios shall be selected to reflect “worst-case” while still realistic conditions, e.g. 0% grid shift between operators.
* Moderator Recommendation:
  + Discussion on the proposals firstly.
* Agreement:
  + The group will define the case/scenarios for additional co-existence, with the assumptions to be discussed in details.