**3GPP TSG-RAN WG4 Meeting #112 R4-2413407**

**Maastricht, Netherlands, 19th – 23rd August, 2024**

**Agenda item:** 8.19.4

**Source:** Moderator (Samsung)

**Title:** Topic summary for [112][307] NR\_duplex\_evo\_General

**Document for:** Information

# Introduction

In RAN#102, the work item on evolution of NR duplex operation (SBFD) has been approved [RP-234035], with WID further revised in the follow-up RAN plenary [RP-240789]. According to the objectives in WID, RAN1 is tasked to specify the mechanisms to support SBFD, including semi-static indication of time/frequency location, random access in SBFD symbols, and other transmission, reception and measurement behavior and procedures for SBFD aware UE. Furthermore, the enhancement for CLI handing, including gNB-to-gNB and UE-to-UE CLI handling, will also be specified in RAN1. Accordingly, from RAN4 perspective, it is tasked to “Specify BS RF requirements for SBFD operation at gNB [RAN4]”.

This document is provided for the moderator summary of thread [307] on Rel-19 work item on evolution of NR duplex operation (SBFD) for general aspect and potentially new requirements for SBFD, in which the following highlighted agenda items are supposed to be covered specifically:

|  |
| --- |
| * 1. Evolution of NR duplex operation: Sub-band full duplex (SBFD) [NR\_duplex\_evo]      1. General aspects (including RAN4 aspects for SBFD system parameters) [NR\_duplex\_evo-Core]      2. BS RF requirements [NR\_duplex\_evo-Core]         1. Potentially new requirements for SBFD operation for FR1 and FR2-1 [NR\_duplex\_evo-Core]         2. Modification of existing Tx requirements for FR1 and FR2-1 [NR\_duplex\_evo-Core]         3. Modification of existing Rx requirements for FR1 and FR2-1 [NR\_duplex\_evo-Core]      3. RRM core requirements [NR\_duplex\_evo-Core]      4. Moderator summary and conclusions [NR\_duplex\_evo] |
|  |

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411018 | Charter Communications, Inc | Draft CR by adding the agreed sentence “Therefore, it is expected that new SBFD operators in AMBIT band or in C-Band will seek a fair coexistence with legacy TDD operating in CBRS band.” |
| R4-2411019 | Charter Communications, Inc | Observation 1: New SBFD operation in locations nearby legacy CBRS operators may cause adjacent channel interference to the legacy networks. Hence, in TR 38.858 paragraph 12.2.1 North America, we propose to add a summary sentence regarding SBFD: “Therefore, it is expected that new SBFD operators in AMBIT band or in C-Band will seek a fair coexistence with legacy TDD operating in CBRS band.”  Observation 2: In the recent 3GPP RAN4 way forward [3], the below proposal is agreed.  Observation 3: Since TR 38.858 is owned by RAN1 and paragraph 12.2.1 is owned by RAN4, we propose in both RAN1 [4] and in RAN4 [5] to agree to change the text below.  Proposal: In TR 38.858 paragraph 12.2.1 North America, we propose to add a summary sentence regarding SBFD: “Therefore, it is expected that new SBFD operators in AMBIT band or in C-Band will seek a fair coexistence with legacy TDD operating in CBRS band.” |
| R4-2411297  Moved from AI 8.19.2.1 | Charter Communications, Inc | Observation 1: there are no guard bands between the AMBIT band and the CBRS band, as well as there are no guard bands between the CBRS band and the C-band.  Observation 2: Both the AMBIT band and the CBRS band are configured as 10 MHz channel bandwidth bands.  Proposal 1: Define the SBFD feature as a band specific feature and have Operators drive the requirement of SBFD in a per band basis.  Proposal 2: We propose the value of X for channel bandwidth shall be greater than10 MHz channel bandwidth.  Proposal 3: Restrict SBFD to operate in bands with channel bandwidths of X≤10 MHz. |
| R4-2411070 | CATT | Observation 1: A new specification for SBFD BS or new clauses with suffixes in TS 38.104 works for SBFD RF requirements. New specification is slightly preferred.  Proposal 1: Operating band and BW support for SBFD feature are declare based for the RF requirements.  Proposal 2: RF requirements are defined without consideration of CLI handling.  Proposal 3: The RF requirements can be defined based on the declared sub-band configuration and guard band size.  Proposal 4: The following high level principles can be considered to solve the concerns of declaration based sub-band configuration and GB size.  1）Both DUD and DU patterns are supported by the conformance test.  2）RB allocation can be full RB for sub-band D, relative smaller specific BW for sub-band U FRC is used, for example, 10MHz for FR1 FRC and 20 MHz for FR2 FRC can be considered.  3) The test shall be performed on each of B, M and T in sub-band U. |
| R4-2411512 | Qualcomm Germany | Observation 1: SBFD can be operated in any TDD with sufficient channel bandwidth.  Proposal 1: If RAN4 agreed to consider SBFD support for a given TDD band as declaration based, it is viable to include the following text in Clause 5.2 in TS 38.104: subband full duplex can be applied to TDD bands given in Table 5.2-1.  Proposal 2: RAN4 should consider a band-generic and technical criteria for exclusion of certain TDD bands when considering the SBFD feature. Such a natural criterion is the band bandwidth being less than X MHz.  Proposal 3: RAN4 to agree on the value of X after agreeing on the minimum guard band requirements and subband sizes for both DUD and DU subband configurations.  Proposal 4: RAN4 to define RF requirements with no CLI handling as a baseline and revisited particular RF requirements pending on RAN1 progress on the CLI handling work.  Proposal 5: RAN4 to define RF requirements for all channel bandwidths that satisfy the minimum channel bandwidth criteria (i.e., larger than X MHz).  Observation 2: An agnostic configuration approach in relation to the subband configuration should be considered in order not to restrict the normative work to a set of subband configurations.  Proposal 6: RAN4 to consider no restriction on the subband sizes when defining the RF requirements.  Proposal 7: To enhance the readability of the spec, it is preferable to have standalone sub-clauses in core specs for SBFD-specific existing or new gNB RF requirements. |
| R4-2411637 | Samsung | Proposal 1: For introducing BS RF requirements for SBFD-capable BS, RAN4 shall adopt the way of creating new and standalone sub-clauses in TS 38.104 by setting up new sub-clauses with suffix-B.  Proposal 2: SBFD is a feature with requirements of which can potentially be applied to all TDD band, with Option 1 (declaration-based method) being adopted, i.e.,   * Option 1: Declaration based method   + The band supported for SBFD shall be manufacturer declaration based   + The channel bandwidth supported for SBFD shall be manufacturer declaration based   Proposal 3: When specifying RAN4 requirements for SBFD-capable BS, SBFD symbols (instead of SBFD slots/symbols) shall be used to designate the time domain duration in which SBFD related requirements is applied.  Proposal 4: All channel bandwidths shall be defined for RF requirements  Proposal 5: The following limitation/restriction of the size of subband and guardband shall be considered as baseline:   * Subband (including both UL/DL subband):   + Granularity: 1 RB   + Possible Subband size (expressed in RBs): {Xmin, Xmin+1,..., Xmax}     - Xmin = 1     - Xmax = NRB (i.e., Transmission bandwidth configuration) * Guardband:   + Granularity: 1 RB   + Possible guardband size (expressed in RBs): {0, 1, 2, ..., Ymax}     - Where Ymax is the maximum allowed number of RBs for guardband       * FFS the value of Ymax   Proposal 6: A new 5.3B clause 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 SBFD5.3B.1 General <To add the illustrative 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 andSubband configuration for SBFD <To be added>  =================== End of Text Proposal =================== |
| R4-2411736 | CMCC | Proposal 1: for RF spec structure of SBFD requirements, it’s better to create new sub-clauses in TS 38.104 which capture all new and existing RF requirements that applies for SBFD.  Proposal 2: Define the general principle for SBFD:  - Channel bandwidth for middle TDD bands should be equal to or larger than 30MHz.  - Channel bandwidth for high TDD bands should be equal to or larger than 60MHz.  Proposal 3: 100MHz, 60MHz and 30MHz are suggested as typical channel bandwidth to support SBFD.  Proposal 4: To keep the flexibility of SBFD, no restriction should be set for subband size, and some typical subband size could be specified in the spec.  Proposal 5: One typical value or the maximum value of the guard band size should be specified in the spec. |
| R4-2412080 | vivo | **Proposal 1:** It is suggested to adopt Table 1 only for deriving BS RF requirements purpose and no restriction to RAN1 definition for UL/DL subband sizes within the transmission configuration for this channel bandwidth.  **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 | … |   **Proposal 2:** The typical NRB configurations for DL or UL subbands can still follow the transmission bandwidth configuration in TS 38.104.  **Proposal 3:** The guardband between UL/DL subbands can be in the range of [0, GBmax], and GBmax can refer to Table 3.  Table 3. The maximum guard band between DL and UL subband for SBFD   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **SCS (kHz)** | **5 MHz** | **10 MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **35**  **MHz** | **40**  **MHz** | **45**  **MHz** | **50**  **MHz** | **60**  **MHz** | **70**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100**  **MHz** | | 15 | 242.5 | 312.5 | 382.5 | 452.5 | 522.5 | 592.5 | 572.5 | 552.5 | 712.5 | 692.5 | N/A | N/A | N/A | N/A | N/A | | 30 | 505 | 665 | 645 | 805 | 785 | 945 | 925 | 905 | 1065 | 1045 | 825 | 965 | 925 | 885 | 845 | | 60 | N/A | 1010 | 990 | 1330 | 1310 | 1290 | 1630 | 1610 | 1590 | 1570 | 1530 | 1490 | 1450 | 1410 | 1370 | |
| R4-2412576 | Huawei, HiSilicon | Observation: While potentially SBFD can be applied to all TDD bands, example bands for SBFD RF requirement discussion can be selected as U6G, 4.9GHz and 3.5GHz.  Proposal 1: Specify following subband configurations for SBFD.  • Pattern #1: ‘DU’, i.e. 80MHz (or 60MHz) for the DL subband and 20MHz (or 40MHz) for the UL subband  • Pattern #2: ‘DUD’, i.e. 40MHz for the two DL subbands and 20MHz for the UL subband  Proposal 2: The size of guard band for SBFD should be manufacturer declaration based:  • It can be different for different BS classes  • Not to have limitation on the minimum/maximum value of the size of guard band  Proposal 3: For single carrier operation, the supported BS CBW for SBFD should be no less than 60MHz and applying 100MHz as maximum.  Proposal 4: For CA operation, the SBFD can be supported on only one of the carriers, and the supported CBW for this carrier should be no less than 60MHz and applying 100MHz as maximum.  • For instance, 100MHz CC for SBFD + N\*100MHz CC, where N could be e.g. 1, 2, and 3  Proposal 5: New clauses for each requirement for SBFD can be added in TS 38.104, details like whether new suffix for SBFD is needed or not can be further determined when the discussion on RF requirements can be stable.  Proposal 6: RAN4 define RF requirements for the frequency outside of wanted carrier based on no CLI handling as baseline. |
| R4-2412721 | ZTE Corporation, Sanechips | Proposal 1: adopt the Option 1 declaration based approach to declare the system parameters supported by the SBFD operation;  Proposal 2:  at least the FRC of UL sub-band for SBFD sensitivity requirement should be defined and the following basic principle could be taken into account.  1. The same DMRS pattern or configuration as legacy REFSENS requirements;  2. MCS index 4 and target coding rate = 308/1024 are adopted to calculate payload size for receiver sensitivity and in-channel selectivity  3. To define the ratio of UL transmission bandwidth configuration per BW according to the DL/UL traffic. e.g. 20% of transmission bandwidth configuration per BW for FRC design. For example, 100MHz, 30KHz, the number of PRB for FRC design is floor (273PRB\*20%)=54PRB.  4. RESENS =-174dBm/H+10\*log(BW of above FRC)+NF+SNR+IM+[1dB];  Where  − NF follow the legacy FR1/FR2-1 BS assumption;  − SNR is assumed as -1dB to avoid the repeating simulation for different configuration since MCS 4 is fixed.  − IM is assumed as 2dB;  − Additional 1dB performance degradation  Proposal 3: DL sub-band and the guard band is proposed up to the declaration.  Proposal 4: postpone the decision for Issue 2-1-1 until RAN4 reached the consensus on full sets of RF requirements of SBFD BS.  Proposal 5: RAN4 don’t need to mention any feasible BS implementation in the specification and RAN4 only need to ensure the reasonable performance regardless from coexistence performance or its link performance within the serving cells.  Proposal 6: RAN4 could derive the interference signal power level of in-band blocking requirement by system level simulation with 99.99% statistical CDF curve of blocking levels from aggressor system in DL direction and no CLI coordination among different carriers.  Proposal 7: RAN4 define the requirement for outside of wanted carrier based on no CLI coordination as baseline. |
| R4-2412913 | Ericsson | Observation 1 Wide guardband can consume valuable bandwidth. When the bandwidth is low, after excluding the guard band, the remaining PRBs for both DL and UL sub-bands may become insufficient. Such a situation is not practical in real-world deployments.  Proposal 1 A general principle should be applied when deploying SBFD: The channel bandwidth shall be larger than 50 MHz.  Proposal 2 RAN4 define RF requirements for the frequency outside of wanted carrier based on no CLI handling as baseline.  Proposal 3 RAN4 create new specifications for SBFD-capable BS.  Proposal 4 Reuse the existing channel bandwidths for SBFD subbands.  Proposal 5 SBFD-capable BS channel bandwidths are down selected to 50 MHz and 100 MHz for FR1, 200 MHz and 400 MHz for FR2-1. RAN4 define SBFD subband configurations as shown in table 1 for FR1 and table 2 for FR2-1.  Proposal 6 For FR1, use 30 kHz as the SCS for SBFD slots. For FR2-1, use 120 kHz as the SCS for SBFD slots.  Proposal 7 Reuse the existing transmission bandwidth configuration NRB for SBFD.  Proposal 8 RAN4 define SBFD transmission bandwidth configuration NRB as shown in table 3 for FR1 and table 4 for FR2-1.  Proposal 9 For LA BSs, reuse the existing guardbands for SBFD. For WA BSs, wider guardbands than existing ones are needed for SBFD and need FFS. |
| R4-2413238 | Nokia | Observation 1: Supporting SBFD for small carrier bandwidths, e.g. < 40 MHz, is unpractical since the SBFD guardbands may become excessive with respect to the usable data resource blocks, and it becomes also challenging to place reference signals and channels such as SSB and CORESET 0.  Proposal 1: RAN4 to not consider any CLI handling scheme impact on the RF requirements discussions.  Proposal 2: For FR1, RAN4 to prioritize SBFD requirements for BS carrier bandwidths between 50 MHz and 100 MHz.  Proposal 3: SBFD configurations with both DUD and DU arrangement of the subbands should be supported. The size of the UL subband should be around 20% of the channel bandwidth.  Proposal 4: For FR1 SBFD requirements, the size of the UL subband is aligned with the transmission bandwidth configurations specified in TS 38.104. That is 51 RBs for a 20 MHz channel and 30 kHz SCS.  Proposal 5: For FR1 SBFD requirements, from base station perspective, the following assumptions for guardbands and UL and DL subbands can be used as starting point:  a. For FR1 DUD configuration in 100 MHz channel and 30 kHz SCS: < ND, NU, NG > = <106, 51, 5>  b. For FR1 DU or UD configuration in 100 MHz channel and 30 kHz SCS: < ND, NU, NG > = <217, 51, 5>  Proposal 6: For FR2-1 SBFD requirements, from base station perspective, the following assumptions for guardbands and UL and DL subbands can be used as starting point:  a. For FR2-1 DUD configuration in 100 MHz channel and 120 kHz SCS: < ND, NU, NG > = <25, 14, 1>  b. For FR2-1 DUD configuration in 200 MHz channel and 120 kHz SCS: < ND, NU, NG > = <52, 26, 1>  Proposal 7: The value of guardbands, DL and UL subbands for SBFD operation in the field are not restricted to those in RAN4 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.  Proposal 8: Requirements are defined for a limited number of SBFD configurations (considering different bandwidth, center frequency, and DUD or DU arrangement). Limit the number of SBFD configurations to five for FR1, and three for FR2-1. |

## Open issues summary

### Sub-topic 1-1: Draft CR to TR 38.858

##### Issue 1-1-1: Adding a summary sentence in sub-clause 12.2.1

* [Moderator] Quoted from Charter’s Tdoc (R4-2411019) :
  + In TR 38.858 paragraph “12.2.1 North America”, Charter proposed to add a summary sentence regarding SBFD: “Therefore, it is expected that new SBFD operators in AMBIT band or in C-Band will seek a fair coexistence with legacy TDD operating in CBRS band.” Since RAN1 owns TR 38.858 and RAN4 owns sub-clause 12.2.1, RAN4 would need to endorse this CR before an LS is going out to RAN1 for final approval.
* Moderator Recommendation:
  + Since the sentence is already technically endorsed in the WF in RAN#111 [R4-2409958], the draft CR [R4-2411018] can straightforwardly be endorsed.

### Sub-topic 1-2: SBFD frequency domain issues (Band/Channel BW/SCS/Subband configuration support and guardband restriction)

##### Issue 1-2-1: Band/channel bandwidth support for SBFD

* [Moderator] Here is the agreement from RAN4#111.

|  |
| --- |
| *<From RAN4#111>*  **Issue 1-1-1: SBFD as band specific or general feature to all TDD bands**   * Agreement:   + SBFD is a feature with requirements of which can potentially be applied to all TDD band, under the following considerations:     - Option 1: Declaration based method       * The band supported for SBFD shall be manufacturer declaration based       * The channel bandwidth supported for SBFD shall be manufacturer 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. |

* [Moderator] Additional consideration, under which to define the SBFD feature with requirements of which can potentially be applied to all TDD band:
  + Option 1 (CATT, Samsung, ZTE, Qualcomm): Declaration-based method, and SBFD is not restricted on any band or channel bandwidth:
    - The band supported for SBFD shall be manufacturer declaration based
      * Proposal 1-1 (Samsung): All channel bandwidths shall be defined for RF requirements.
    - The channel bandwidth supported for SBFD shall be manufacturer declaration based
  + Option 2 (Qualcomm, CMCC, Huawei, Ericsson, Nokia, Charter): General principle on channel bandwidth, e.g., the channel bandwidth shall be larger than X MHz
    - RAN4 to define RF requirements for all channel bandwidths that satisfy the minimum channel bandwidth criteria (i.e., larger than X MHz):
      * Proposal 2-1 (Huawei): X=60
      * Proposal 2-2 (Ericsson, Nokia): X=50
      * Proposal 2-3 (CMCC): Proposals for detailed value of X:
        + X=30 for middle TDD bands;
        + X=60 for high TDD bands
      * Proposal 2-4 (Charter): X=10
    - Proposal 2-5 (Huawei): For channel bandwidth, applying 100MHz as maximum
    - Proposal 2-6 (Qualcomm): To include the following text in Clause 5.2 in TS 38.104: subband full duplex can be applied to TDD bands with bandwidth > X MHz, given in Table 5.2-1.
    - Proposal 2-7 (Qualcomm): RAN4 to agree on the value of X after agreeing on the minimum guard band requirements and subband sizes for both DUD and DU subband configurations
    - Proposal 2-8 (Nokia): For FR1, RAN4 to prioritize SBFD requirements for BS carrier bandwidths between 50 MHz and 100 MHz. For FR2, both 100MHz and 200MHz.
    - Proposal 2-9 (Charter): Define the SBFD feature as a band specific feature and have Operators drive the requirement of SBFD in a per band basis.
  + Option 3 (CMCC, Ericsson, vivo): Typical channel bandwidth introduced:
    - Proposal 3-1 (CMCC): 100MHz, 60MHz and 30MHz are suggested as typical channel bandwidth to support SBFD.
    - Proposal 3-2 (Ericsson): 50 MHz and 100 MHz for FR1, 200 MHz and 400 MHz for FR2-1
    - Proposal 3-3 (vivo): 25, 50, 100 and 200MHz
* Moderator Recommendation:
  + Further discussion on the above options.

##### Issue 1-2-2: SCS support for SBFD

* [Moderator] For SBFD requirements to be defined, the supported SCS(s) is discussed:
  + Proposal 1 (Ericsson, Nokia): For FR1, use 30 kHz as the SCS for SBFD slots. For FR2-1, use 120 kHz as the SCS for SBFD slots
* Moderator Recommendation:
  + Further discussion on above proposal, and this issue could be discussed together with Issue 1-2-1.

##### Issue 1-2-3: Transmission bandwidth configuration NRB for SBFD

* [Moderator] For transmission bandwidth configuration NRB for SBFD, and it should be noted that the definition of transmission bandwidth configuration NRB for SBFD is not yet fully clarified.
  + Proposal 1 (Ericsson, vivo): Reuse the existing transmission bandwidth configuration NRB for SBFD.
  + Proposal 2 (Ericsson): RAN4 define SBFD transmission bandwidth configuration NRB as shown in table 3 for FR1 and table 4 for FR2-1.
    - Table 3: SBFD Transmission bandwidth configuration NRB for FR1

|  |  |  |
| --- | --- | --- |
| SCS (kHz) | 50 MHz | 100 MHz |
| NRB | NRB |
| 30 | [106] | [218] |

* + - Table 4: SBFD Transmission bandwidth configuration NRB for FR2-1

|  |  |  |
| --- | --- | --- |
| SCS (kHz) | 200 MHz | 400 MHz |
|  | NRB | NRB |
| 120 | [99] | [198] |

* Moderator Recommendation:
  + It should be noted that the definition of transmission bandwidth configuration NRB for SBFD is not yet fully clarified:
    - Whether it should be corresponding to channel BW or DL/UL subband
  + Further discussion on above proposals.

##### Issue 1-2-4: DL/UL subband configurations support for SBFD

* [Moderator] For how to handle guard band and subband configurations in specification, the following agreement is achieved in RAN4#111:

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| --- |
| **Issue 1-2-2: How to handle guard band and subband configurations in specification**   * Agreement:   + Add clarification that only DUD and DU patterns are specified 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) |

* Options proposed:
  + Option 1 (CATT, Qualcomm, CMCC, Samsung, ZTE): RF requirements can be defined based on the declared supported UL/DL subbands configuration(s) (i.e., no restriction on the subband sizes when defining the RF requirements).
    - Proposal 1-1 (Samsung): No limitation for the size of subband:
      * Subband (including both UL/DL subband):
        + Granularity: 1 RB
        + Possible Subband size (expressed in RBs): {Xmin, Xmin+1,..., Xmax}

Xmin = 1

Xmax = NRB (i.e., Transmission bandwidth configuration)

* + - Proposal 1-2 (CATT): In addition to Option 1, the following principles are proposed in order not to restrict the normative work to a set of subband configurations:
      * Both DUD and DU patterns are supported by the conformance test.
      * RB allocation can be full RB for sub-band D, relative smaller specific BW for sub-band U FRC is used, for example, 10MHz for FR1 FRC and 20 MHz for FR2 FRC can be considered.
      * The test shall be performed on each of B, M and T in sub-band U.
    - Proposal 1-3 (ZTE): at least the FRC of UL sub-band for SBFD sensitivity requirement should be defined and the following basic principle could be taken into account.
      * The same DMRS pattern or configuration as legacy REFSENS requirements;
      * MCS index 4 and target coding rate = 308/1024 are adopted to calculate payload size for receiver sensitivity and in-channel selectivity
      * To define the ratio of UL transmission bandwidth configuration per BW according to the DL/UL traffic. e.g. 20% of transmission bandwidth configuration per BW for FRC design. For example, 100MHz, 30KHz, the number of PRB for FRC design is floor (273PRB\*20%)=54PRB.
      * RESENS =-174dBm/H+10\*log(BW)+NF+IM+1dB;

Where

* + - * + NF follow the legacy FR1/FR2-1 BS assumption;
        + SNR is assumed as -1dB to avoid the repeating simulation for different configuration since MCS 4 is fixed.
        + IM is assumed as 2dB;
        + Additional 1dB performance degradation
  + Option 2 (Ericsson, Huawei, Nokia, vivo): Specify requirement based on selected subband configuration for SBFD:
    - Proposal 2-1 (Ericsson): Reuse the existing channel bandwidths for SBFD subbands, by down-selecting to 50 MHz and 100 MHz for FR1, 200 MHz and 400 MHz for FR2. RAN4 define SBFD subband configurations as shown in table 1 for FR1 and table 2 for FR2-1.

Table 1: BS SBFD configuration for FR1

| **Subband allocation** | **BS channel bandwidth**  **(MHz)** | | | |
| --- | --- | --- | --- | --- |
| **50** | **50** | **100** | **100** |
| DL Subband 1 | 20 | 40 | 40 | 80 |
| UL Subband | 10 | 10 | 20 | 20 |
| DL Subband 2 | 20 | N/A | 40 | N/A |

Table 2: BS SBFD configuration for FR2-1

| **Subband allocation** | **BS channel bandwidth**  **(MHz)** | | | |
| --- | --- | --- | --- | --- |
| **200** | **200** | **400** | **400** |
| DL Subband 1 | 75 | 150 | 150 | 300 |
| UL Subband | 50 | 50 | 100 | 100 |
| DL Subband 2 | 75 | N/A | 150 | N/A |

* + - Proposal 2-2 (Huawei): Specify following subband configurations for SBFD:
      * Pattern #1: ‘DU’, i.e. 80MHz (or 60MHz) for the DL subband and 20MHz (or 40MHz) for the UL subband
      * Pattern #2: ‘DUD’, i.e. 40MHz for the two DL subbands and 20MHz for the UL subband
    - Proposal 2-3 (Nokia): The size of the UL subband should be around 20% of the channel bandwidth. From BS perspective, the following assumptions for guardbands and UL and DL subbands can be used as starting point:
      * FR1:
        + For FR1 DUD configuration in 100 MHz channel and 30 kHz SCS: < ND, NU, NG > = <106, 51, 5>
        + For FR1 DU or UD configuration in 100 MHz channel and 30 kHz SCS: < ND, NU, NG > = <217, 51, 5>
      * FR2:
        + For FR2-1 DUD configuration in 100 MHz channel and 120 kHz SCS: < ND, NU, NG > = <25, 14, 1>
        + For FR2-1 DUD configuration in 200 MHz channel and 120 kHz SCS: < ND, NU, NG > = <52, 26, 1>
    - Proposal 2-4 (Nokia): The value of guardbands, DL and UL subbands for SBFD operation in the field are not restricted to those in RAN4 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.
    - Proposal 2-5 (Nokia): Requirements are defined for a limited number of SBFD configurations (considering different bandwidth, center frequency, and DUD or DU arrangement). Limit the number of SBFD configurations to five for FR1, and three for FR2-1.
    - Proposal 2-6 (vivo): It is suggested to adopt Table 1 only for deriving BS RF requirements purpose and no restriction to RAN1 definition for UL/DL subband sizes within the transmission configuration for this channel bandwidth.

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 | … |

* Moderator Recommendation:
  + Discuss on Options/Proposals firstly.
  + Seems the below bullet can be agreed firstly.
    - SBFD configurations with both DUD and DU arrangement shall be specified.

##### Issue 1-2-5: Restriction on guardband size for SBFD

* [Moderator] Based on last meeting’s agreement, 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). So whether the restriction on RB numbers for guardband is needed is discussed:
  + Option 1 (Ericsson): Definition based on existing guardbands requirement in TS38.104 (i.e., minimum guardband)
    - For LA BSs, reuse the existing guardbands for SBFD. For WA BSs, wider guardbands than existing ones are needed for SBFD and need FFS.
  + Option 2 (Nokia): Typical values of guardband defined for requirement, but the guardband should not be restricted to those in RAN4 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.)
  + Option 3 (Samsung, CMCC, vivo): No restriction (manufacturer declaration-based), but with restriction on maximum allowed number of RBs for guardband:
    - Possible guardband size (expressed in RBs): {0, 1, 2, ..., Ymax}
      * Where Ymax is the maximum allowed number of RBs for guardband
        + FFS the value of Ymax
        + Proposal 3-1 (vivo): Ymax refer to below table 3 for different channel bandwidth:

Table 3. The maximum guard band between DL and UL subband for SBFD

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SCS (kHz)** | **5 MHz** | **10 MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **35**  **MHz** | **40**  **MHz** | **45**  **MHz** | **50**  **MHz** | **60**  **MHz** | **70**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100**  **MHz** |
| 15 | 242.5 | 312.5 | 382.5 | 452.5 | 522.5 | 592.5 | 572.5 | 552.5 | 712.5 | 692.5 | N/A | N/A | N/A | N/A | N/A |
| 30 | 505 | 665 | 645 | 805 | 785 | 945 | 925 | 905 | 1065 | 1045 | 825 | 965 | 925 | 885 | 845 |
| 60 | N/A | 1010 | 990 | 1330 | 1310 | 1290 | 1630 | 1610 | 1590 | 1570 | 1530 | 1490 | 1450 | 1410 | 1370 |

* + Option 3a (Huawei, ZTE): No restriction (manufacturer declaration-based), and no restriction on maximum/minimum number of RBs for guandband:
    - The size of guardband can be different for different BS classes
* Moderator Recommendation:
  + Discuss on Options/Proposals further.

##### Issue 1-2-6: Specification implementation issue for BS channel BW for SBFD

* [Moderator] Text proposal is given for specification implementation for BS channel bandwidth for SBFD.
  + Proposal 1 (Samsung): A new 5.3B clause 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 add the illustrative 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 ===================

* Moderator Recommendation:
  + Further discussion on the above proposal.

### Sub-topic 1-3: SBFD time-domain terminology

##### Issue 1-3-1: SBFD time-domain terminology

* [Moderator] In the existing RAN4 study (including the conclusions captured in TR 38.858 [2]) and subsequential RAN4 discussion in the work item phase, the term “SBFD and non-SBFD slots/symbols” are used. Based on the RAN1 agreements, one time slot can consist of SBFD symbols and non-SBFD symbols:

|  |
| --- |
| *<From RAN1#116>*  **Agreement**  A slot can consist of SBFD symbols and non-SBFD symbols. |

* Proposal related to SBFD time-domain terminology
  + Proposal 1 (Samsung): When specifying RAN4 requirements for SBFD-capable BS, SBFD symbols (instead of SBFD slots/symbols) shall be used to designate the time domain duration in which SBFD related requirements is applied.
* Moderator Recommendation:
  + Discussion on the above proposal firstly.

### Sub-topic 1-4: Other general issues for SBFD requirements

##### Issue 1-4-1: CLI handling impact on RF requirement

* [Moderator] The following agreement on CLI handling impact on RF requirement is provided in RAN4#111:

|  |
| --- |
| * 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 |

* The CLI handling impact on RF requirement are discussed with the following options proposed:
  + Option 1 (CATT, Huawei, Qualcomm, Ericsson, Nokia): RAN4 define RF requirements for the frequency outside of wanted carrier based on no CLI handling as baseline
    - Proposal 1 (Qualcomm): Revisit particular RF requirements pending on RAN1 progress on the CLI handling work.
* Moderator Recommendation:
  + Discussion on the above option/proposal further.

##### Issue 1-4-2: BS RF Specification structure for SBFD requirements

* [Moderator] Based on RAN4#111 discussion, the follow agreement is achieved. Accordingly, BS RF specification structure for SBFD requirements shall be further discussed in this meeting.

|  |
| --- |
| *<From RAN4#111>*  **Issue 1-4-1: BS RF Specification structure for SBFD requirements**   * 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 |

* Options of how to introduce BS RF new requirements for SBFD-capable BS:
  + Option 1: Embedding the corresponding SBFD RF requirements in the corresponding section of TS 38.104 (similar as NB-IoT RF requirement in TS36.104)
  + Option 2 (Samsung, CATT, Qualcomm, CMCC, Huawei, Nokia): Creating new sub-clauses in TS 38.104 for RF requirements that applies for SBFD
    - Option 2a (Huawei): details (like new suffix or not) can be FFS when RF requirements are stable.
    - Option 2b (Qualcomm, Samsung): Set up new sub-clause with suffix-B for modified existing RF requirements and SBFD-dedicated new RF requirements
  + Option 3 (CATT, Ericsson): A new specification for SBFD BS RF requirements
  + Option 4 (ZTE): Postpone the decision until RAN4 reached the consensus on full sets of RF requirements of SBFD BS.
* Moderator Recommendation:
  + Discuss further on whether or not Option 2 can be agreed as baseline.

# Topic #2: Potentially new requirements for SBFD

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411082 | CATT | Observation: Existing transient period is a pure Tx requirement for TDD BS. The on/off power is measured for this requirement test.  Proposal 1: The intention and the detail for the SBFD transient period requirement should be clarified before this requirement is defined.  Proposal 2: Location of transient period between SBFD and non-SBFD shall be located within the SBFD slot if it needs to be decided.  Proposal 3: The following new requirements are not defined for SBFD BS.  – In-channel adjacent subband leakage ratio  – In-channel adjacent subband selectivity  – In-channel adjacent subband blocking |
| R4-2411298  Withdrawn | Charter Communications, Inc | Withdrawn |
| R4-2411513 | Qualcomm Germany | Observation 1: Additional time might be needed for an SBFD-capable gNB to adjust its operation when transitioning between SBFD and non-SBFD slot/symbol.  Proposal 2: RAN4 to adopt legacy TDD transient period requirements in Section 6.4.2.2 and 9.5.3 for the FR1 and FR2-1 SBFD-capable gNB.  Proposal 3: RAN4 to define transient period requirements impendent of a given SBFD configuration.  Observation 2: The in-channel subband sub-band Tx leakage and selectivity new requirements depend on the self-interference, inter-site and inter-sector interference considerations.  Proposal 4: RAN4 to first define scenarios and assumptions required for the definition of the in-channel adjacent subband leakage and selectivity. |
| R4-2411640 | Samsung | **Observation 1:** Based on RAN1 agreement, for both one or two TDD-UL-DL pattern(s) configured, SBFD symbols are configured in consecutive manner within each TDD-UL-DL pattern period.  **Observation 2:** There will be one SBFD to non-SBFD transition and one non-SBFD-to-SBFD transition within a TDD-UL-DL pattern period.  **Proposal 1:** For transmitter transient period between SBFD and non-SBFD, the existing TDD BS transmitter transient period, i.e., 10ms for FR1 and 3ms for FR2-1, can be reused for all four cases:   |  |  |  | | --- | --- | --- | |  | **Frequency regions for Transition** | **BS transmitter behavior during transition** | | Case-A (SBFD to DL) | SBFD UL subband and guardband(s) | BS transmitter OFF-to-ON | | Case-B (SBFD to UL) | SBFD DL subband | BS transmitter ON-to-OFF | | Case-C (DL to SBFD) | SBFD UL subband and guardband(s) | BS transmitter ON-to-OFF | | Case-D (UL to SBFD) | SBFD DL subband | BS transmitter OFF-to-ON |   **Proposal 2:** The transmitter transient period shall be located within the SBFD symbol.  **Proposal 3:** For transmitter transient period between different SBFD reconfigurations, RAN4 study the necessity of introducing requirement by considering the following cases:   1. Case-1 (reconfigured to reduce RB(s) for SBFD UL): There exists some RB(s), which are from SBFD UL to SBFD DL during the transition, while other RBs remain either SBFD UL or SBFD DL during the transition. 2. Case-2 (reconfigured to add RB(s) for SBFD UL): There exists some RB(s), which are from SBFD DL to SBFD UL during the transition, while other RBs remain either SBFD UL or SBFD DL during the transition. 3. Case-3 (reconfigured SBFD UL except Case-1 or 2): There exists some RB(s) which are from SBFD UL to SBFD DL and some RB(s) which are from SBFD UL to SBFD DL during the transition, while other RBs either SBFD UL or SBFD DL during the transition.   **Observation 3:** It is difficult for RAN4 to agree on a reference scheme for self-interference suppression implemented to derive the potential new requirement in-channel adjacent subband leakage ratio.  **Observation 4:** All the gNB-to-gNB CLI handling schemes likely to be introduced in RAN1 (including beam nulling, beam pairing and non-transparent UL resource muting) will greatly mitigate the gNB-to-gNB CLI, and make it be hard to have a criterion for a “proper” interference level or in-channel adjacent subband leakage ratio.  **Proposal 4:** There is no necessity to introduce new requirement for in-channel adjacent subband leakage ratio.  **Proposal 5:** There is no necessity to introduce new requirement for in-channel adjacent subband blocking and adjacent subband selectivity. |
| R4-2411734 | CMCC | Observation 1: the transient period for SBFD should not be larger than legacy ON-OFF transient period. Besides, the transient period between SBFD reconfiguration should not be larger than the transient period from SBFD to non-SBFD.  Observation 2: This sub-band Tx leakage falling into the same carrier can be discussed together with OTA sensitivity requirements.  Observation 3: RAN4 should at first identify the assumption of adjacent network performance for sub-band leakage requirement definition, i.e. whether inter-operator using adjacent carrier follow legacy 3GPP requirement or allow enhanced performance.  Observation 4: Sub-band selectivity requirements when Tx interference is within the same carrier can be discussed together with OTA sensitivity requirements. If OTA sensitivity will encompass these sub-band interference, sub-band selectivity with Tx interference signal within carrier is not needed.  Observation 5: RAN4 should at first identify the assumption of adjacent network performance for sub-band selectivity requirement definition, i.e. whether inter-operator using adjacent carrier follow 3GPP requirement or allow enhanced performance.  Proposal 1: both sub-band selectivity and blocking requirements should be defined. |
| R4-2412577 | Huawei, HiSilicon | Observation: For in-channel adjacent subband leakage ratio derivation, it is difficult for RAN4 to agree on a reference scheme for self-interference suppression. While the REFSENS for SBFD will reflect such suppression to some extent.  Proposal 1: For SBFD-capable BS, check if 10us can be reused as transmitter transient period for following cases:  • Case #1: Between SBFD slot and non-SBFD slot (The transmitter transient period is within the SBFD slot)  • Case #2: Between SBFD slots with different subband configurations  Proposal 2: Prefer not to introduce new requirement for in-channel adjacent subband leakage ratio.  Proposal 3: Prefer not to introduce new requirement for in-channel adjacent subband selectivity or blocking. |
| R4-2412722 | ZTE Corporation, Sanechips | Proposal 1: for the co-site inter-sector, in-channel blocking, in-channel selectivity and in-channel sub-band leakage, this could be left up to the vendor declaration without defining any specific power or freq offset of the corresponding requirement.  Proposal 2: for the inter-site scenario, propose to further discuss how to handle the BS CLI problem e.g. with RAN4 minimum RF requirement (usually worst assumptions) or with other coordination schemes defined in other WGs. |
| R4-2412914 | Ericsson | Observation 1 The same considerations on inter-site interference due to switching occur for SBFD resources when switched between TX/RX as when the whole slot is switched.  Proposal 1 Apply the existing TDD switching time and off level requirement to SBFD RBs when they are switched between TX and RX.  Proposal 2 Apply the same transient period to transition between non-SBFD slots and SBFD slots as for normal full DL and UL switching.  Proposal 3 There is no need to specify transmitter transient period requirement between different SBFD configurations.  Proposal 4 Define a requirement on TX sub-band ACLR similar to the ACLR requirement and use existing ACLR requirement as baseline.  Proposal 5 Define a requirement on RX sub-band ACS similar to the ACS requirement and use existing ACS requirement as baseline. |
| R4-2413209  (Moved to AI 18.9.3) | MediaTek inc. | Already moved to AI 18.9.3, so not be treated in this email thread.  This should be in RRM thread, i.e., [112][221] NR\_duplex\_evo |
| R4-2413237 | Nokia | Observation 1: Separate sub-clauses are the clearest way to introduce new sub-clauses in TS 38.104.  Observation 2: Creation a new separate specification will complex BS specifications and increase efforts to maintenance both core and test specifications, and thus it should be avoided.  Observation 3: Depending on the antenna configuration option, a transition time may be needed between normal slot and SBFD slots.  Observation 4: The OTA sensitivity requirement does not capture the effects from co-site inter-sector and inter-site interference.  Observation 5: In-channel adjacent subband leakage ratio, in-channel adjacent subband blocking and in-channel adjacent subband selectivity requirements cannot be guaranteed implicitly by the OTA sensitivity requirement, since the methods used for self-interference cancellation, might not be available for cancelling interference from other sectors and gNBs, especially when considering a multi-vendor deployment.  Observation 6: Even though RAN4 has not agreed on a reference implementation for SBFD operation, minimum requirements can still be defined to enable proper operation considering self-interference, co-site inter-sector and inter-site interference.  Proposal 1: For introduction of new BS RF requirements for SBFD operation, creating new sub-clauses is proposed.  Proposal 2: Use existing transient period requirement as a baseline for transition between normal slot and SBFD slots.  Proposal 3: RAN4 to define in-channel adjacent sub-band leakage ratio requirements within SBFD time slots considering inter-sector interference and inter-site interference. Existing ACLR requirements could be used as baseline depending on the ratio between the bandwidths of the DL and the UL subbands.  Proposal 4: RAN4 to define in-channel adjacent sub-band selectivity, the exact requirement limits to be discussed. |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

*Before f2f meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1: Requirements for Transient period between SBFD and non-SBFD

#### Issue 2-1-1: Requirement for transient period between SBFD and non-SBFD

* [Moderator] In RAN4#111, the following agreement is achieved for the requirement for transient period between SBFD and non-SBFD:

|  |
| --- |
| * Agreement:   + FFS requirement and cases for transient period between SBFD and non-SBFD:     - Option 1: The existing TDD BS transmitter transient period, i.e., 10us for FR1 and 3us for FR2-1     - Other options are not precluded.   + FFS location of transient period between SBFD and non-SBFD:     - Option 1: The transmitter transient period shall be located within the SBFD slot     - Other options are not precluded. |

* General principal proposals:
  + Proposal 1 (CATT): The intention and the detail for the SBFD transient period requirement should be clarified before this requirement is defined.
  + Proposal 2 (Qualcomm): RAN4 to adopt legacy TDD transient period requirements in Section 6.4.2.2 and 9.5.3 for the FR1 and FR2-1 SBFD-capable gNB.
  + Proposal 3 (Qualcomm): RAN4 to define transient period requirements impendent of a given SBFD configuration.
  + Proposal 4 (Ericsson): Apply the existing TDD switching time and off level requirement to SBFD RBs when they are switched between TX and RX.
  + Proposal 5 (Ericsson): Apply the same transient period to transition between non-SBFD slots and SBFD slots as for normal full DL and UL switching.
  + Proposal 6 (Nokia): Use existing transient period requirement as a baseline for transition between normal slot and SBFD slots.
* Cases for transmitter transient period between SBFD and non-SBFD:
  + Proposal 7 (Samsung): four cases identified:

|  |  |  |
| --- | --- | --- |
|  | **Frequency regions for Transition** | **BS transmitter behavior during transition** |
| Case-A (SBFD to DL) | SBFD UL subband and guardband(s) | BS transmitter OFF-to-ON |
| Case-B (SBFD to UL) | SBFD DL subband | BS transmitter ON-to-OFF |
| Case-C (DL to SBFD) | SBFD UL subband and guardband(s) | BS transmitter ON-to-OFF |
| Case-D (UL to SBFD) | SBFD DL subband | BS transmitter OFF-to-ON |

* Moderator Recommendation:
  + Discussion on the above proposals firstly.
  + Check if the group can firstly confirm the requirement for transmitter transient period between SBFD and non-SBFD shall be introduced for the four cases in the above table.

#### Issue 2-1-2: Transient period length between SBFD and non-SBFD

* [Moderator] There are some observations/proposal, but not directly categorized to options:
  + Observation 1 (CMCC): The transient period for SBFD should not be larger than legacy ON-OFF transient period.
* Transient period length between SBFD and non-SBFD:
  + Option 1 (Ericsson): The existing TDD BS transmitter transient period, i.e., 10us for FR1 and 3us for FR2-1
    - Proposal 1-1 (Huawei): 10us for FR1
* Moderator Recommendation:
  + Check if Option 1 can be agreed or not:

#### Issue 2-1-3: Location of transient period between SBFD and non-SBFD

* Location of transient period between SBFD and non-SBFD:
  + Option 1 (CATT/Samsung/Huawei): Location of transient period between SBFD and non-SBFD shall be located within the SBFD slot/symbol if it needs to be decided.
* Moderator Recommendation:
  + Check if Option 1 can be agreed or not:

### Sub-topic 2-2: Requirements for Transient period between different SBFD configurations

#### Issue 2-2-1: Requirement for transient period between different SBFD configurations

* [Moderator] The necessity of the requirement for transient period between different SBFD configurations has not yet been confirmed, based upon previous meeting discussion.
* Proposals on transient period between different SBFD configurations:
  + Proposal 1 (Samsung): RAN4 study the necessity of introducing requirement by considering the following cases:
    - Case-1 (reconfigured to reduce RB(s) for SBFD UL): There exists some RB(s), which are from SBFD UL to SBFD DL during the transition, while other RBs remain either SBFD UL or SBFD DL during the transition.
    - Case-2 (reconfigured to add RB(s) for SBFD UL): There exists some RB(s), which are from SBFD DL to SBFD UL during the transition, while other RBs remain either SBFD UL or SBFD DL during the transition.
    - Case-3 (reconfigured SBFD UL except Case-1 or 2): There exists some RB(s) which are from SBFD UL to SBFD DL and some RB(s) which are from SBFD UL to SBFD DL during the transition, while other RBs either SBFD UL or SBFD DL during the transition.
  + Proposal 2 (Ericsson): No need to specify transmitter transient period requirement between different SBFD configurations.
* Moderator Recommendation:
  + Discussion on above proposals firstly.
  + If no strong preference and consider Rel-19 is the first release for SBFD, suggest to follow Proposal 2 to minimize the work load.

#### Issue 2-2-2: Transient period length between different SBFD configurations

* [Moderator] There are some observations/proposal, but not directly categorized to options:
  + Observation 1 (CMCC): The transient period between SBFD reconfiguration should not be larger than the transient period from SBFD to non-SBFD.
* Transient period length between different SBFD configurations:
  + Option 1: The existing TDD BS transmitter transient period, i.e., 10us for FR1 and 3us for FR2-1
    - Proposal 1-1 (Huawei): 10us for FR1
* Moderator Recommendation:
  + Check if Option 1 can be agreed or not:

### Sub-topic 2-3: In-channel adjacent subband leakage ratio requirements

#### Issue 2-3-1: Necessity of in-channel adjacent subband leakage ratio requirements

* [Moderator] The necessity of the requirement for in-channel adjacent subband leakage ratio requirements has not yet been confirmed, based upon previous meeting discussion.
* Proposals:
  + Option 1 (Samsung/CATT/Huawei): no necessity to introduce new requirement for in-channel adjacent subband leakage ratio.
  + Option 2 (Ericsson/Nokia): New requirement for in-channel adjacent subband leakage ratio should be defined.
    - Proposal 2-1 (Ericsson/Nokia): Define a requirement on TX sub-band ACLR similar to the ACLR requirement and use existing ACLR requirement as baseline.
* Moderator Recommendation:
  + Further discussion on both options.
  + This issue can be discussed combined with Issue 2-3-2.

#### Issue 2-3-2: The way to derive requirement for in-channel adjacent subband leakage ratio if agreed to be introduced

* Proposals:
  + Proposal 1 (Qualcomm): RAN4 to first define scenarios and assumptions required for the definition of the in-channel adjacent subband leakage and selectivity.
  + Observation 1 (CMCC): RAN4 should at first identify the assumption of adjacent network performance for sub-band leakage requirement definition, i.e. whether inter-operator using adjacent carrier follow legacy 3GPP requirement or allow enhanced performance.
  + Proposal 2 (ZTE): Separate the discussion between the co-site inter-sector and inter-site scenario:
    - For in-channel sub-band leakage, this could be left up to the vendor declaration without defining any specific power or freq offset of the corresponding requirement.
    - For inter-site scenario, propose to further discuss how to handle the BS CLI problem e.g. with RAN4 minimum RF requirement (usually worst assumptions) or with other coordination schemes defined in other WGs.
  + Proposal 3 (Nokia): RAN4 to define in-channel adjacent sub-band leakage ratio requirements within SBFD time slots considering co-site inter-sector interference and inter-site interference. Existing ACLR requirements could be used as baseline depending on the ratio between the bandwidths of the DL and the UL subbands.
* Moderator Recommendation:
  + Discussion on these proposals firstly.

### Sub-topic 2-4: In-channel adjacent subband selectivity/blocking requirements

#### Issue 2-4-1: Necessity of in-channel adjacent subband selectivity requirements

* [Moderator] The necessity of the requirement for in-channel adjacent subband selectivity requirements has not yet been confirmed, based upon previous meeting discussion.
* Proposals:
  + Option 1 (Samsung/CATT/Huawei): no necessity to introduce new requirement for in-channel adjacent subband selectivity.
  + Option 2 (CMCC/Ericsson/Nokia): New requirement for in-channel adjacent subband selectivity should be defined.
    - Proposal 2-1 (Ericsson): Define a requirement on RX sub-band ACS similar to the ACS requirement and use existing ACS requirement as baseline.
* Moderator Recommendation:
  + Further discussion on both options.
  + This issue can be discussed combined with Issue 2-4-3.

#### Issue 2-4-2: Necessity of in-channel adjacent subband blocking requirement

* [Moderator] The necessity of the requirement for in-channel adjacent subband blocking requirements has not yet been confirmed, based upon previous meeting discussion.
* Proposals:
  + Option 1 (Samsung/CATT/Huawei): no necessity to introduce new requirement for in-channel adjacent subband blocking.
  + Option 2 (CMCC): New requirement for in-channel adjacent subband blocking should be defined.
* Moderator Recommendation:
  + Further discussion on both options.
  + This issue can be discussed combined with Issue 2-4-3.

#### Issue 2-4-3: The way to derive requirements for in-channel adjacent subband selectivity/blocking if agreed to be introduced

* Proposals:
  + Proposal 1 (Qualcomm): RAN4 to first define scenarios and assumptions required for the definition of the in-channel adjacent subband leakage and selectivity.
  + Observation 1 (CMCC): Sub-band selectivity requirements when Tx interference is within the same carrier can be discussed together with OTA sensitivity requirements. If OTA sensitivity will encompass these sub-band interference, sub-band selectivity with Tx interference signal within carrier is not needed.
  + Observation 2 (CMCC): RAN4 should at first identify the assumption of adjacent network performance for sub-band selectivity requirement definition, i.e. whether inter-operator using adjacent carrier follow 3GPP requirement or allow enhanced performance.
  + Proposal 2 (ZTE): Separate the discussion between the co-site inter-sector and inter-site scenario:
    - For in-channel sub-band selectivity/blocking, this could be left up to the vendor declaration without defining any specific power or freq offset of the corresponding requirement.
    - For inter-site scenario, propose to further discuss how to handle the BS CLI problem e.g. with RAN4 minimum RF requirement (usually worst assumptions) or with other coordination schemes defined in other WGs.
* Moderator Recommendation:
  + Discussion on the proposal firstly.