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

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

**Agenda item:** 10.12.3

**Source:** Samsung

**Title:** Way Forward for [110bis][313] NR\_duplex\_evo

**Document for:** Approval

# Introduction

This document is provided for capturing agreements and way forward on the WI of NR\_duplex\_evo based on the discussion in RAN4#110bis.

# For Agreement (already discussed in offline)

## General aspects (including RAN4 aspects for SBFD system parameters)

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

* 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

* 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

* 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

* 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

* 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

## Modification of existing requirements - TX

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

* 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

* 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

* 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.

# For Agreement (not yet fully discussed in offline)

## General aspects (including RAN4 aspects for SBFD system parameters)

#### Issue 1-1-5: Region limitation for subband full duplex

* Agreement:
	+ The following revision to clause 12 is agreed to be adopted in TR38.858.

### *<< Start of changes >>*

### 12.2.1 North America

In the United States, TDD network operators operating in proximal geographic areas in adjacent bands are encouraged and sometimes required to synchronize their networks and coordinate their TDD configurations to avoid mutual interference. Unsynchronized operation is allowed, more stringent regulation parameters have not been specified for such case but, again, operators would have to work their differences to avoid any claim to Federal Communications Commission (FCC) and Innovation, Science and Economic Development Canada (ISED). FCC requires 3450 – 3550 MHz service (AMBIT band) licensees to negotiate with 3550 – 3700 MHz (CBRS band) licensees to enable TDD synchronization across these services [55]-[56]. Notice that the term TDD synchronization refers to aligning TDD uplink and downlink slots. FCC recognizes the potential for harmful interference from a high-power AMBIT band downlink transmission to a CBRS band uplink. Licensees in the 3700 – 3980 MHz band (C-Band) are encouraged to explore synchronization of TDD operations to minimize interference between adjacent band services [57].

The shared band 48/n48 (3550 – 3700 MHz), also known as the CBRS band, requires spectrum sharing among three tiers of users controlled by one or multiple spectrum access systems (SASs) [58]. Coexistence, including TDD synchronization, among cellular users within the band is supported by OnGo Alliance coexistence requirements set forth in OnGo-TS-2001 [59].

The ISED Canada is reallocating portions of the 3500 to 4200 MHz band as TDD bands for cellular use. The ISED is considering TDD synchronization as a means of facilitating sharing and co-existence with adjacent band services [60].

Currently there are no specific regulatory requirements for SBFD operation in North America. Some SBFD operations result in similar interference scenarios as found in unsynchronized TDD systems. The potential coexistence risk introduced by SBFD may break the standard body agreement on TDD synchronization by OnGo Alliance coexistence requirements set forth in OnGo-TS-2001 [59]. 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.

### *<< End of changes >>*

## Modification of existing requirements - TX

#### Issue 2-3-2: OBUE

* Agreement:
	+ Further discuss how to define OBUE requirement for SBFD capable BS in order to ensure feasible co-existence performance for SBFD BSs operating in adjacent frequency.

## Potentially new requirements for SBFD

#### Issue 4-3-1: Requirement for transient period between SBFD and non-SBFD

* Agreement:
	+ Requirement for 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:
			* Case-A (SBFD to DL): transmitter OFF-to-ON in SBFD UL band and guard band(s)
			* Case-B (SBFD to UL): transmitter ON-to-OFF in SBFD DL band
			* Case-C (DL to SBFD): transmitter ON-to-OFF in SBFD UL band and guard band(s)
			* Case-D (UL to SBFD): transmitter OFF-to-ON in SBFD DL band
		- Location of transient period between SBFD and non-SBFD:
			* The transmitter transient period shall be located within the SBFD slot

#### Issue 4-3-2: Requirement for transient period between different SBFD configurations

* Agreement:
	+ FFS requirement for transient period between different SBFD configurations

# Way Forward (new)

## Modification of existing requirements - RX

#### Issue 3-4-1 & Issue 3-4-2: Necessity for additional co-existence study for In-band blocking and Scenario/Case for additional co-existence study (if agreed)

* Way forward:
	+ ~~The group will define the case/scenarios for additional co-existence, with the assumptions to be discussed in details.~~
	+ Companies are encouraged to provide the co-existence study results for in-band blocking in the next meeting:
		- The scenarios to be studied are Scenario 1, 3, 5, 6, 9, defined in TR 38.858
		- The case to be studied is Case 3 (TDD DL to SBFD UL subband).
		- FFS the power level which should be collected from the simulation results to derive in-band blocking levels:
			* Option-1: absolute power level of interference from adjacent channel only, i.e., SBFD network internal interference should not be considered in the simulation, from the perspective of definition of in-band blocking requirement.
			* Other options are not precluded.
		- FFS the reference point for the power level which should be before or after RX beamforming.
			* Option-1: after RX subarray beamforming gain and before array gain, i.e, at TAB.
		- FFS different grid-shift values should be considered.
			* Option-1: 10%.
			* Option-2: Other percentage values are not precluded.
		- FFS how to use the power level probability distributions to derive the in-band blocking levels
			* Option-1: Find the X% tile of the UL SBFD wideband received power CDF to define the blocking requirement in each of the down-selected scenarios.
				+ FFS the value of X
				+ FFS the impact of CLI handling scheme introduced in RAN1 which can be used for adjacent channel CLI mitigation.