3GPP TSG-RAN WG4 Meeting #104e R4-2214376

Electronic Meeting, 15th– 26th Aug, 2022

**Title: Reply LS on interference modelling for duplex evolution**

**Response to: LS in R1-2205543/R4-2211510 on interference modelling for duplex evolution**

**Release: Rel-18**

**Work Item:** **FS\_NR\_duplex\_evo**

**Source: RAN WG4**

**To: RAN WG1**

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**Attachments:**

# 1 Overall description

RAN4 thanks RAN1 for sharing the agreement on interference type for Rel-18 NR duplex evolution study. For the questions regarding the interference modelling for SBFD operation in SLS from RAN1, RAN4#104e discussed and concluded the reply as follows:

1. Agreement on RAN4 feasibility study and RF requirement impact for SBFD operation
* From gNB perspective
	+ If found feasible, SBFD operation requires new/enhanced implementation for gNB capable of SBFD and cannot be software upgraded to existing BS
	+ No impact on requirement applied to existing gNB or gNB not capable of SBFD operation.
* From UE perspective
	+ Using existing UE RF requirements to estimate UE performance and if needed extrapolating them for system level studies
* Criteria on gNB UL receiver sensitivity degradation due to self-interference
	+ Taking 1dB sensitivity degradation due to self-interference of DL transmission as starting point for system level evaluation and feasibility study
		- Other values lower than 1dB e.g. 0.1dB/0.8dB not precluded pending on the feasibility study
		- Final values used in co-existence evaluation shall be aligned with feasibility analysis conclusion.
1. Reply to gNB self-interference modelling for system level simulation

The range for value of Ratio of gNB self-interference cancellation with respect to each aspect requested in RAN1 LS is summarized in table 1 according to available input during RAN4#104e. Please note that the detailed range for each parameters in table 1 are superset of results provided from source companies and RAN4 may see more analysis at the next meeting. The feasibility of the values has not been concluded and at this point of time the information should be used only for simulator development and calibration. It is quite likely that, as the feasibility assessment progresses, the value ranges of the different parameters will vary.

Table 1: value range of RSIC

|  |  |  |
| --- | --- | --- |
| **Parameter** | **FR1(Frequency Range 1)** | **FR2(Frequency Range 2)** |
| Spatial isolation  | 50~80dBc | 80-120 dBc |
| Frequency isolation | 45 dBc  | 22.5~30 dBc |
| Beam nulling /isolation | 0~40 dBc | 0~40 dBc |
| Digital IC  | 0~50 dBc | 0~50 dBc |
| Overall RSIC capability  | 95 ~185 dBc | 102.5~ 205 dBc |
| NOTE1: Other isolation schemes could be discussed further.NOTE 2: Both transmitter leakage to the RX sub-band and interference arising from receiver imperfections need to be considered. Receiver imperfections may reduce the RSIC to be lower than the RSIC considering transmitter leakage alone. RAN4 will assess impact of Rx impairments on the RSIC capability. But the RSIC model can potentially be simplified to address impact from both aspects together.  |

On granularity in frequency domain and question on frequency flat model possibility (Question 1-1/3/5 in R1-2205543), RAN4 agreed that RSI can be modelled as (almost) frequency flat at least could be scaled to sub-band level. And RAN4 will further discuss on below aspects:

* FFS on guard band assumption between sub-band for SBFD
* FFS on necessity/feasibility of RB level scaling

On RSI dependency on Blocking and AGC (Question 1-4 in R1-2205543), RAN4 has below agreements:

* The in-band blocking is suggested to applied as starting point to ensure the receiver of UL sub-band is not blocked due to DL sub-band transmission
	+ Besides blocking, LNA and dynamic range can be FFS for receiver side
* AGC may be applied to adjust the receiver gain to avoid ADC saturation if spatial isolation and analog IC, if found feasible, don’t provide enough reduction to self-interference. This may result in cost of an impact on sensitivity and potentially reduced coverage. However, it seems not feasible to model this in SLS.

On dependency on gNB antenna and beam related (Question 1-5 in R1-2205543) RAN4 has below agreements:

* gNB antenna architecture has impact on RSI model as to achieve high spatial isolation, separate antenna panels between TX and RX chain is requested
* TX/RX beamforming can further contribute on RSI pending on implementation.
* The RSI will have dependency at least on the listed factors in RAN1 LS, but further details will need to be studied in RAN4.
1. Reply to gNB-gNB and UE-UE co-channel inter-subband CLI modelling for system level simulation

In context of gNB-gNB co-channel CLI modelling, RAN4 agree to distinguish co-site and inter-site scenarios.

* Co-site inter-sector gNB-gNB co-channel inter-subband CLI modelling: similar modelling as for self-interference (RSI) can be applied but may be with different parameters especially on antenna isolation.
	+ RAN4 will study further on possibility to apply digital IC for this case, but has not yet concluded whether it is feasible
* Inter-site gNB-gNB co-channel inter-subband CLI modelling: The same transmitter leakage and receiver impairment model as used for investigating gNB self-interference, but antenna isolation is replaced with inter-site isolation. The candidates for TX leakage and Receiver impairment are as below:
	+ TX leakage candidate: gNB ACLR
	+ Receiver impairment candidate: gNB ACS

RAN4 will further study the possibility of improved performance/requirements compared to existing referred requirements list above.

In context of UE-UE co-channel inter-subband CLI modelling, RAN4 agree on below candidates requirements specified in TS38.101-1 and TS38.101-2 for FR1 and RF2 respectively.

* TX model can refer to existing UE requirement in TS38.101-1 and TS38.101-2
	+ In-band emission as starting point, which defines a per-RB emission across the channel
	+ RAN4 is still studying whether ACLR may also apply in certain restricted configurations
* RX model can refer to existing UE requirement in TS38.101-1 and TS38.101-2
	+ Maximum input power as threshold based on above specification
	+ In-channel selectivity requirements for the UE are not defined, and RAN4 is still investigating the feasibility of providing an indicative co-channel Rx modelling in the presence of interference.
1. Reply to gNB-gNB and UE-UE adjacent-channel CLI modelling for system level simulation

In context of gNB-gNB adjacent-channel CLI modelling, it’s also suggested to distinguish co-site and inter-site scenarios.

* Co-site gNB-gNB adjacent-channel: RAN4 will study further with below options
	+ Alternative 1: ACLR and ACS based with potential other solution from SBFD capable gNB to reduce co-site adjacent channel interference (i.e. ACLR from the SBFD gNB towards the victim or ACS impact from the aggressor towards the SBFD gNB)
		- A non-SBFD aggressor or victim in the adjacent channel should be assumed to have ACLR or ACS according to the RAN4 specifications
		- RAN4 will further study the possibility of improved performance/requirements compared to existing referred requirements list above for SBFD capable gNB
	+ Alternative 2: similar modelling as for self-interference(RSI) can be applied but may with different parameters especially on antenna isolation and required overall isolation if both gNBs with SBFD capability
		- And digital IC is not feasible if gNBs belong to different operators for this case
* Inter-site gNB-gNB adjacent channel: RAN4 agree to apply gNB ACLR based model on TX and gNB ACS requirements based model on RX. And RAN4 will further study on separate calculation from ACLR and ACS perspective to address potential different antenna gain for wanted signal and unwanted signal.

In addition, RAN4 may further study the possibility of improved performance/requirements compared to existing referred requirements list above.

In context of UE-UE adjacent-channel CLI modelling, RAN4 agree on UE ACLR based model on TX and UE ACS based model on RX which is the same ACIR model as Rel-16 CLI study as starting point. ACLR and ACS requirement are defined on channel in RAN4 specification. And RAN4 will discuss further on other candidates.

Reference:

[1] R4-2214377, WF on feasibility study from RF perspective

# 2 Actions

**To RAN WG1**

**ACTION:** RAN4 kindly asks RAN1 to consider above answers in future discussion.

# 3 Dates of next RAN WG 4 meetings

TSG RAN WG4 Meeting #104bis-e 10th –19th Oct, 2022 e-meeting

TSG RAN WG4 Meeting #105 14th – 18th Nov, 2022 EU