**3GPP TSG RAN WG1 #110bis-e**  **R1-22XXXXX**

**e-Meeting, October 10th – 19th, 2022**

**Agenda item:** 9.3.1

**Source:** Moderator (CMCC)

**Title:** Summary# on evaluation on NR duplex evolution

**Document for:** Discussion/decision

# Introduction

The SI Study on evolution of NR duplex operation was approved in RAN plenary #94-e meeting [1], and the latest updated SID was approved in RAN plenary #97 e-meeting [2].

In this contribution, we summarized the related issues and proposals based on the contributions submitted in RAN1#110bis-e under the agenda item 9.3.1 [3]-[26].

The following sections are structured as follows. From section 2 to 4, we categorize the key issues raised by contributions into 3 kinds and some sections may cover more than one sub-issue. For each issue/sub-issue, we provide the related submitted proposals, the summary and initial proposals/questions suggested by moderator in sub-sections. For each identified proposal/question, one table is provided.

# Issue#1: Deployment scenarios

## Issue#1-1: Scenarios for SBFD

### Submitted proposal

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| **Company** | **Proposals** |
| CMCC | ***Proposal 1:*** For evaluation of SBFD Deployment Case 3-2, consider the following scenarios for FR1:   * (Optional) 2-layer Scenario A (Dense Urban with 2-layer)   + Layer 1: Dense Urban Macro layer   + Layer 2: Dense Urban Micro layer * (Optional) 2-layer Scenario B   + Layer 1: Urban Macro   + Layer 2: Indoor office or Indoor factory (companies to report which one is used)     - Regarding the Indoor office layer, reuse the Indoor office (InH) scenario and relevant channel model in TR38.901.     - Regarding the Indoor factory layer, reuse the Indoor factory (InF) scenario and relevant channel model in TR38.901. * Layer 1 uses legacy static TDD operation, Layer 2 uses SBFD operation. All the gNBs in Layer 2 use the same SBFD subband configuration.   ***Proposal 2:*** For SBFD Deployment Case 4, reuse the evaluation assumptions of the scenarios in SBFD Deployment Case 1 as much as possible. |
| Huawei (R1-2208408) | ***Proposal 3:*** *Deployment Case 3-2 (HetNet scenario) with an Urban Macro layer and an indoor Pico layer at FR1 should be considered for SBFD evaluation:*   * *Indoor factory/office layer with SBFD;* * *Urban Macro layer with DL dominant TDD.* |
| ZTE | ***Proposal 2:*** *For SBFD Deployment Case 2, at least consider the following scenarios for evaluation:*   * *For FR1,*   + *Dense Urban with 2-layer (use Dense Urban defined in TR38.802/TR38.901 as starting point)*     - *Macro and micro use different SBFD configurations*   + *(Optional) Urban macro (use Urban macro defined in TR38.802/TR38.901 as starting point)* * *For FR2-1,*   + *(Optional) Dense Urban Macro layer (use Dense Urban defined in TR38.802 as starting point)*   + *(Optional) Dense Urban micro (use Dense Urban micro defined in TR38.802/TR38.901 as starting point)*   ***Proposal 3:*** *For SBFD Deployment Case 3, at least consider the following scenarios for evaluation:*   * *For FR1,*   + *Case 3-2: Dense Urban with 2-layer (use Dense Urban defined in TR38.802/TR38.901 as starting point)*     - *Macro is legacy TDD and micro applies the same SBFD configurations*   + *Case 3-2: Urban Macro + Indoor office*     - *Urban Macro is legacy TDD and Indoor office applies the same SBFD configurations*   + *Case 3-1: (Optional) Urban macro (use Urban macro defined in TR38.802/TR38.901 as starting point)* * *For FR2-1,*   + *Case 3-1: (Optional) Dense Urban Macro layer (use Dense Urban defined in TR38.802 as starting point)*   + *Case 3-1: (Optional) Dense Urban micro (use Dense Urban micro defined in TR38.802/TR38.901 as starting point)* |
| Ericsson (R1-2209174) | Proposal 12: RAN1 to prioritize agreeing system level simulation assumptions for deployment Case 4 in RAN1 #110b-e.  Proposal 13: RAN1 to further down-select scenarios where SBFD performance improvements may be realistically possible and can be simulated/evaluated by participating entities.  Proposal 14: RAN1 to agree that for evaluation of SBFD deployment Case 3-2 and Case 4 and dynamic/flexible TDD consider an outdoor-indoor scenario for FR1:   * 1. Outdoor- Indoor scenario      1. Outdoor: Urban Macro without UE clustering      2. Indoor: Indoor office or Indoor factory (companies to report which one is used)         1. Regarding the Indoor office layer, reuse the Indoor office (InH) scenario and relevant channel model in TR38.901.         2. Regarding the Indoor factory layer, reuse the Indoor factory (InF) scenario and relevant channel model in TR38.901.   2. For SBFD Case 3-2: Layer 1 (Outdoor) uses legacy static TDD operation. Layer 2 (Indoor) uses SBFD operation. All the gNBs in Layer 2 use the same SBFD subband configuration. The two layers are deployed in the same carrier.   3. For SBFD Case 4: Operator 1 (Outdoor) uses legacy static TDD operation, Operator 2(Indoor) uses SBFD operation. All the gNBs for Operator 2 use the same SBFD subband configuration. The two layers are deployed in adjacent carriers.   4. For dynamic TDD/Flexible TDD: Layer 1 uses legacy static TDD operation with DL dominant static TDD UL/DL configuration. Layer 2 uses flexible TDD configuration or companies to report configuration used.   Proposal 15: For the TDD configuration for Case 3-2 and Case 4, the following needs to be considered   * 1. Baseline: All gNBs in both layers and both operators use a common static TDD configuration: DDDSU   2. Option 1: All gNBs in Layer1/Operator 1 uses a static TDD configuration: DDDSU. All gNBs in Layer2/Operator 2 uses a SBFD configuration XXXSU or a flexible TDD configuration FFFFU.   3. Option 2: All gNBs in Layer1/Operator 1 uses a static TDD configuration: DDDSU. All gNBs Layer2/Operator 2 uses a SBFD configuration XXXXX or a flexible TDD configuration FFFFF.   4. Option 3: All gNBs in Layer1/Operator 1 uses a static TDD configuration: DDDSU. All gNBs in layer 2/Operator 2 use legacy static TDD operation with the same UL dominant static TDD UL/DL configuration.      1. FFS: UL dominant static TDD UL/DL configuration based on realistic deployments. |
| Qualcomm | **Observation 1: Subband full duplex deployment for Massive MIMO macro cell deployment with large EIRP could benefit from UL coverage gain and latency improvement while it is a challenging deployment due to large self-interference at gNB.**  **Observation 2: Subband full duplex deployment Indoor deployment may reduce requirements on gNB for self-interference mitigation due to small Tx Power. However, at least for FR1, it may be challenging deployment for handling cross link-interference.**  **Observation 3: Deployment case 1 with same UL/DL subband configurations across all cells is more practical from deployment perspective as compared to Deployment case 2.**  **Observation 4: Deployment case 4 is important for Rel-18 study to evaluate the effect on the legacy/SBFD operator and legacy UE due to adjacent channel cross-link interference.**  **Proposal 1: For Deployment case 1, support HetNet with Urban Macro and Indoor as an optional deployment scenario at least for FR1.**  **Proposal 2: For Deployment case 4, Urban Macro (FR1) and Dense Urban Macro layer (FR2-1) deployment are considered as baseline for the study of adjacent channel coexistence between SBFD and static TDD operator.**   * **Further discussion on additional scenarios of Indoor hotspot and Dense urban Micro layer scenarios.**   **Observation 5: Grid shift of 0% and 100% between the two operators’ gNB are sufficient to study best case and worst-case adjacent channel coexistence between the SBFD and static TDD operator (Deployment case 4).** |
| Nokia | **Proposal 3: For evaluation of SBFD Deployment Case 4 (Adjacent-channel co-existence case), consider** **Urban Macro (FR1) and Dense urban (FR1, FR2) as the main scenarios.** |
| MediaTek | ***Proposal 1: No further prioritization between the deployment cases for SBFD is pursued in RAN1.*** |
| Xiaomi | **Proposal 1: The following aspects corresponding to deployment case 3 need to be further clarified:**   * **For 1-layer case, dense urban Macro or Urban macro scenario is adopted** * **For 2-layer case, dense urban Macro with two layers is adopted**   + **The SFBD gNB deployment needs further clarification, i.e. per layer deployment or mixed deployment across layers.** |
| Spreadtrum | ***Proposal 2.*** *Urban macro and indoor scenarios can be considered for evaluations in this study, where the indoor scenarios represent the most significant UE-to-UE CLI effects.* |
| Intel | **Proposal 1:**   * **For SBFD case 3, the following scenarios are considered for evaluation in RAN1:** * **2-layer Scenario A (Dense Urban with 2-layer)** * **Layer 1: Dense Urban Macro layer** * **Layer 2: Dense Urban Micro layer** * **Dense Urban Macro layer uses legacy static TDD operation, Dense Urban Micro layer uses SBFD operation. All the Micro gNBs use the same SBFD subband configuration.** * **2-layer Scenario B** * **Layer 1: Urban Macro** * **Layer 2: Indoor office or Indoor factory (companies to report which one is used)**   + **Regarding the Indoor office layer, reuse the Indoor office (InH) scenario and relevant channel model in TR38.901.**   + **Regarding the Indoor factory layer, reuse the Indoor factory (InF) scenario and relevant channel model in TR38.901.** * **Layer 1 uses legacy static TDD operation, Layer 2 uses SBFD operation. All the gNBs in Layer 2 use the same SBFD subband configuration.** |

### Summary

**SBFD Deployment Case 1**

For evaluation of SBFD Deployment Case 1, agreements were achieved in the last two meetings.

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| Agreement  For SBFD Deployment Case 1, at least consider the following scenarios for evaluation:   * For FR1,   + Indoor office (use Indoor office defined in TR38.802/TR38.901 as starting point)   + Urban macro (use Urban macro defined in TR38.802/TR38.901 as starting point)     - FFS: UE outdoor/indoor proportion, clustering, etc   + Optional: Dense Urban with 1-layer or 2-layer (use Dense Urban defined in TR38.802/TR38.901 as starting point)   + FFS: Rural * For FR2-1,   + Indoor office (use Indoor office defined in TR38.802/TR38.901 as starting point)   + Dense Urban Macro layer (use Dense Urban defined in TR38.802 as starting point)     - FFS: UE outdoor/indoor proportion, clustering, etc   + Optional: Dense Urban micro (use Dense Urban micro defined in TR38.802/TR38.901 as starting point) * FFS: Whether FR2-2 is considered or not in Rel-18.   Note: For optional scenarios, they can be captured in TR and it is up to each company to provide the results. The results can be used to draw conclusion/recommendation depending on the number of companies providing the results.  **Conclusion**   * For SLS of NR duplex evolution, Rural scenario is not considered in Rel-18. * For NR duplex evolution evaluation, FR2-2 is not considered in Rel-18. |

Qualcomm suggests to support HetNet with Urban Macro and Indoor as an optional deployment scenario at least for FR1 for SBFD Deployment Case 1.

**SBFD Deployment Case 2 and SBFD Deployment Case 3-1**

In RAN1#110 meeting, it was agreed to be discussed SBFD Deployment Case 2 and SBFD Deployment Case 3-1 with low priority.

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| Agreement  For SBFD evaluation from RAN1 perspective, the evaluation assumptions that are specific for Deployment Case 2 and Case 3-1 can be discussed with low priority. |

ZTE shows interests on SBFD Deployment Case 2, and three companies [ZTE, Xiaomi, Intel] show interests on SBFD Deployment Case 3-1.

**SBFD Deployment Case 3-2**

For evaluation of SBFD Deployment Case 3-2,

* Three companies [ZTE, Intel, CMCC] suggest 2-layer Scenario A (Dense Urban with 2-layer) with Dense Urban Macro layer as Layer 1 and Dense Urban Micro layer as Layer 2
* Five companies [Huawei, ZTE, Ericsson, Intel, CMCC] suggest 2-layer Scenario B (HetNet) with Urban Macro as Layer 1 and Indoor office or Indoor factory as Layer 2
* wherein, Layer 1 uses legacy static TDD operation, Layer 2 uses SBFD operation. All the gNBs in Layer 2 use the same SBFD subband configuration.

Moderator suggests **Initial proposal 1-1-1** based on the submitted proposals.

**SBFD Deployment Case 4**

For evaluation of SBFD Deployment Case 4, agreements were achieved in the last two meetings.

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| Agreement  For SBFD Deployment Case 4, at least consider the following scenarios for evaluation from RAN1 perspective:   * FR1: Urban Macro * FR2-1: Dense Urban Macro layer * FFS: UE outdoor/indoor proportion, clustering, etc * FFS: the grid shift between two networks, e.g., 0%, 100%   FFS: Indoor hotspot, Dense Urban Micro layer  Agreement  For evaluation of adjacent-channel coexistence between two networks for Urban Macro and Dense Urban Macro layer scenarios in RAN1, consider grid shifts between two networks of 0% and 100%.   * the topologies shown below can be used for the 0% and 100% grid shift for RAN1 evaluation.   Agreement  RAN1 strives to agree on system level simulation parameters for SBFD deployment case 4 by RAN1#110bis-e with specific focus on different power levels and load levels between two operators in adjacent carriers. |

One company [Ericsson] suggests to consider HetNet with Urban Macro and Indoor for FR1 for SBFD Deployment Case 4. One company [Nokia] suggests to consider Dense urban also for both FR1.

**Others**

One company [Ericsson] suggests to further down-select scenarios where SBFD performance improvements may be realistically possible and can be simulated/evaluated by participating entities.

### 1st Round Proposals

#### ***Initial proposal 1-1-1:***

For evaluation of SBFD Deployment Case 3-2, consider the following scenarios for FR1:

* 2-layer Scenario A (Dense Urban with 2-layer)
  + Layer 1: Dense Urban Macro layer
  + Layer 2: Dense Urban Micro layer
* 2-layer Scenario B
  + Layer 1: Urban Macro
  + Layer 2: Indoor office or Indoor factory (companies to report which one is used)
    - Regarding the Indoor office layer, reuse the Indoor office (InH) scenario and relevant channel model in TR38.901.
    - Regarding the Indoor factory layer, reuse the Indoor factory (InF) scenario and relevant channel model in TR38.901.
* Layer 1 uses legacy static TDD operation, Layer 2 uses SBFD operation. All the gNBs in Layer 2 use the same SBFD subband configuration.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| ZTE | We are supportive to have both Scenario A and Scenario B. For Indoor office vs Indoor factory, we prefer to use indoor office since there are 5 sub-cases for Indoor factory with varying sizes and varying levels of “cluster” density, e.g., machinery, assembly lines, storage shelves, etc. For convergence, it is suggested to focus on Indoor office. |
| Huawei, HiSilicon | Support. Scenario B should be evaluated as the baseline in our view since there are evident commercial use cases. For Scenario A, it can be put it as optional. |
| MediaTek | Support |
| Ericsson | Support the proposal in principle but prefer to down select between the two to reduce the simulations overload. We already have so many simulation scenarios and SBFD configurations assumed. We also prefer Scenario B but with only a single Indoor building office. ***Initial proposal 1-1-1:*** For evaluation of SBFD Deployment Case 3-2, ~~consider~~ down-select between the following scenarios for FR1:   * 2-layer Scenario A (Dense Urban with 2-layer)   + Layer 1: Dense Urban Macro layer   + Layer 2: Dense Urban Micro layer * 2-layer Scenario B   + Layer 1: Urban Macro   + Layer 2: Indoor office or Indoor factory (companies to report which one is used)     - Regarding the Indoor office layer, reuse the Indoor office (InH) scenario and relevant channel model in TR38.901.     - Regarding the Indoor factory layer, reuse the Indoor factory (InF) scenario and relevant channel model in TR38.901.     - FFS: consider only one indoor office/factory drop in an Urban Macro scenario * Layer 1 uses legacy static TDD operation, Layer 2 uses SBFD operation. All the gNBs in Layer 2 use the same SBFD subband configuration. |
| New H3C | We are fine with this proposal |
| QC | Generally okay.  It is good to clarify what is meant by ‘reuse the Indoor office (InH) scenario’ and what can be exactly reused from TR 38.901, e.g., the parameters in Table 7.2-2 and corresponding layout in FIG 7.2-1? |

## Issue#1-2: Scenarios for dynamic/flexible TDD

### Submitted proposal

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| **Company** | **Proposals** |
| CMCC | ***Proposal 3:*** For evaluation of dynamic/flexible TDD for the single operator case, consider the following scenarios:   * FR1   + 1-layer scenario: Indoor office with dynamic TDD UL/DL assignment   + 1-layer scenario: Urban Macro with dynamic TDD UL/DL assignment   + 2-layer Scenario A     - Layer 1: Dense Urban Macro layer     - Layer 2: Dense Urban Micro layer   + 2-layer Scenario B     - Layer 1: Urban Macro     - Layer 2: Indoor office or Indoor factory (companies to report which one is used)       * Regarding the Indoor office layer, reuse the Indoor office (InH) scenario and relevant channel model in TR38.901.       * Regarding the Indoor factory layer, reuse the Indoor factory (InF) scenario and relevant channel model in TR38.901.   + Regarding 2-layer Scenario A and 2-layer Scenario B, the two layers are deployed in the same carrier     - Layer 1 uses legacy static TDD operation with DL dominant static TDD UL/DL configuration     - Layer 2 uses one of the following options (companies to report which option is used)       * Option 1: All gNBs in layer 2 use legacy static TDD operation with the same UL dominant static TDD UL/DL configuration       * Option 2: All gNBs in layer 2 use dynamic TDD UL/DL assignment * FR2-1   + 1-layer scenario: Indoor office with dynamic TDD UL/DL assignment   + 1-layer scenario: Dense Urban Macro layer with dynamic TDD UL/DL assignment * For above scenarios, the following is assumed:   + DL dominant static TDD UL/DL configuration: {DDDSU}, where S=[12D:2G:0U]   + UL dominant static TDD UL/DL configuration: {DSUUU}, where S=[12D:2G:0U]   + dynamic TDD UL/DL assignment: {FFFFF}, companies to report the guard symbols assumed in their simulation |
| Huawei | ***Proposal 7:*** *For HetNet with Urban Macro and indoor office/indoor factory deployed in the same carrier in FR1, more details for evaluation should be determined.*   * *FFS UE distribution and serving cell selection.*   ***Proposal 8:*** *Adjacent-channel coexistence case between dynamic/flexible TDD and legacy TDD can be studied if necessary but RAN1 should try to avoid repeating the same work as in Rel-16.* |
| ZTE | ***Proposal 4:*** *For evaluation of dynamic/flexible TDD, consider the following scenarios for evaluation:*   * *FR1*   + *Indoor office with dynamic TDD UL/DL assignment*   + *HetNet with Urban Macro and Indoor office deployed in the same carrier, and Macro gNBs use DL dominant static TDD UL/DL configuration. Both of the following options can be considered for this scenario.*     - *Option 1 (Baseline): Indoor gNBs use UL dominant static TDD UL/DL configuration*     - *Option 2 (Optional): Indoor gNBs use dynamic TDD UL/DL assignment*   *Note: 3 BSs per 120m x 50m is adopted.*   * + *Adjacent-channel coexistence case between dynamic TDD and legacy TDD*     - *FFS: detailed scenario for adjacent-channel coexistence case*   + *Urban Macro with dynamic TDD UL/DL assignment*   + *Dense Urban with two layers deployed in the same carrier, and Macro gNBs use DL dominant static TDD UL/DL configuration. Both of the following options can be considered for this scenario.*     - *Option 1 (Baseline): Micro gNBs use UL dominant static TDD UL/DL configuration*     - *Option 2 (Optional): Micro gNBs use dynamic TDD UL/DL assignment* * *FR2-1*   + *Indoor office with dynamic TDD UL/DL assignment*   + *Dense Urban Macro layer with dynamic TDD UL/DL assignment* |
| Ericsson | Proposal 14: RAN1 to agree that for evaluation of SBFD deployment Case 3-2 and Case 4 and dynamic/flexible TDD consider an outdoor-indoor scenario for FR1:   1. Outdoor- Indoor scenario    * 1. Outdoor: Urban Macro without UE clustering      2. Indoor: Indoor office or Indoor factory (companies to report which one is used)         1. Regarding the Indoor office layer, reuse the Indoor office (InH) scenario and relevant channel model in TR38.901.         2. Regarding the Indoor factory layer, reuse the Indoor factory (InF) scenario and relevant channel model in TR38.901. 2. For SBFD Case 3-2: Layer 1 (Outdoor) uses legacy static TDD operation. Layer 2 (Indoor) uses SBFD operation. All the gNBs in Layer 2 use the same SBFD subband configuration. The two layers are deployed in the same carrier. 3. For SBFD Case 4: Operator 1 (Outdoor) uses legacy static TDD operation, Operator 2(Indoor) uses SBFD operation. All the gNBs for Operator 2 use the same SBFD subband configuration. The two layers are deployed in adjacent carriers. 4. For dynamic TDD/Flexible TDD: Layer 1 uses legacy static TDD operation with DL dominant static TDD UL/DL configuration. Layer 2 uses flexible TDD configuration or companies to report configuration used. |
| Nokia | ***Observation 1: Companies’ preferences on the deployment scenarios for Rel-18 dynamic TDD are well aligned with the deployment scenarios adopted during Rel-16 coexistence studies.***  **Proposal 1: Unless significant changes on the parameters/assumptions from the previous Rel-16 adjacent coexistence studies are agreed, the previous conclusions remain valid and there is no need to perform new coexistence studies.**  **Proposal 2: For evaluation of dynamic/flexible TDD, consider at least the following co-channel scenarios for FR1:**   * + **Indoor office with dynamic TDD UL/DL assignment**   + **HetNet with Urban Macro and Indoor office deployed in the same carrier, and Macro gNBs use DL dominant static TDD UL/DL configuration. Both of the following options can be considered for this scenario.**     - **Option 1: Indoor gNBs use UL dominant static TDD UL/DL configuration**     - **Option 2: Indoor gNBs use dynamic TDD UL/DL assignment** |
| MediaTek | ***Proposal 2: For the evaluations of DTDD schemes, RAN1 should consider the deployment scenarios listed in Table 1.***   |  |  |  |  | | --- | --- | --- | --- | | Scenario No. | Operator#1 | Operator#2 | Notes | | 1 | Macro | Macro | Grid shift: 0%, 100% | | 2 | HetNet: Macro-Small | Macro | Macro cells: aligned TDD pattern  Indoor cells: misaligned with Macro cells | | 3 | Indoor | Indoor | Misaligned TDD patterns,  Grid shift: between 0% and 100% | |
| CATT | **Proposal 1: The deployment scenarios for dynamic/flexible TDD evaluation in FR1 (4 GHz) at least include indoor office and heterogeneous deployment with Urban Macro and Indoor office.**   * + **Indoor office with dynamic TDD UL/DL assignment**   + **HetNet with Urban Macro and Indoor office deployed in the same carrier**     - **Macro layer use DL dominant static TDD UL/DL configuration: {DDDSU}**     - **Indoor layer use UL dominant static TDD UL/DL configuration: {DSUUU}**   **Proposal 2: The deployment scenarios for dynamic/flexible TDD evaluation in FR2-1(30 GHz) include indoor office and Dense Urban Macro layer.**   * + **Indoor office with dynamic TDD UL/DL assignment**   + **Dense Urban Macro layer with dynamic TDD UL/DL assignment** |
| vivo | ***Proposal 1: For evaluation of dynamic/flexible TDD, consider the following scenarios for evaluation:***   * ***Indoor office with TDD UL/DL configuration that can be updated per [X] slot(s).***    + ***where X≥1, and can be reported by companies.*** * ***HetNet with Urban Macro and Indoor office deployed in the same carrier or adjacent carriers, where Macro gNBs use DL dominant semi-static TDD UL/DL configuration and Indoor gNBs use dynamic TDD UL/DL assignment.*** |
| Xiaomi | **Proposal 8: For flexible/dynamic TDD, evaluate and study the performance in HetNet scenario.** |
| Spreadtrum | ***Proposal 5: In dynamic/flexible TDD, repeated adjacent channel co-existence study should be avoid unless significant parameters changes.***  ***Proposal 6: Hetnet scenarios should not be set as an optional case and Hetnet with Urban Macro and Indoor office should be used in evaluation.***  ***Proposal 7:*** ***For evaluation of dynamic/flexible TDD for the single operator case, following scenario should be removed***  ***• (Optional) Urban Macro with dynamic TDD UL/DL assignment*** |
| Intel | **Proposal 2:**   * **For flexible/dynamic TDD, at least the following scenarios are considered for evaluation:**   + **FR1:**     - **Indoor office with dynamic TDD UL/DL assignment**     - **Urban Macro with dynamic TDD UL/DL assignment**     - **Optional: Dense Urban with two layers deployed in the same carrier, where macro gNBs use DL dominant static TDD UL/DL configuration. Both of the following options can be considered for this scenario:**   **Option 1: Micro gNBs use UL dominant static TDD UL/DL configuration**  **Option 2: Micro gNBs use dynamic TDD UL/DL assignment**   * + **FR2-1:**     - **Indoor office with dynamic TDD UL/DL assignment**     - **Dense Urban Macro layer with dynamic TDD UL/DL assignment**   + **For above scenarios, the following is assumed:**     - **DL dominant static TDD UL/DL configuration: assume {DDDSU}, where S=[12D:2G:0U]**     - **UL dominant static TDD UL/DL configuration: assume {DSUUU}, where S=[12D:2G:0U]** |

### Summary

Regarding evaluation of dynamic/flexible TDD for the single operator case,

* For 1-layer scenarios for FR1,
  + Five companies [ZTE, Nokia, vivo, Intel, CMCC] suggests Indoor office with dynamic TDD UL/DL assignment
  + Three companies [ZTE, Intel, CMCC] suggests Urban Macro with dynamic TDD UL/DL assignment, while one company [Spreadtrum] suggests to remove Urban Macro scenario.
* For 2-layer scenarios for FR1,
  + Three companies [ZTE, Intel, CMCC] suggests 2-layer Scenario A (Dense Urban with 2-layer) with Dense Urban Macro layer as Layer 1 and Dense Urban Micro layer as Layer 2.
  + Nine companies [Huawei, ZTE, Ericsson, Nokia, CATT, vivo, Xiaomi, Spreadtrum, CMCC] suggest 2-layer Scenario B (HetNet) with Urban Macro as Layer 1 and Indoor office or Indoor factory as Layer 2
* For 1-layer scenarios for FR2-1,
  + Four companies [ZTE, CATT, Intel, CMCC] suggests Indoor office with dynamic TDD UL/DL assignment.
  + Four companies [ZTE, CATT, Intel, CMCC] suggests Dense Urban Macro layer with dynamic TDD UL/DL assignment

Note that:

* Regarding 2-layer Scenario A and 2-layer Scenario B, the two layers are deployed in the same carrier
  + Layer 1 uses legacy static TDD operation with DL dominant static TDD UL/DL configuration
  + Layer 2 uses one of the following options (companies to report which option is used)
    - Option 1: All gNBs in layer 2 use legacy static TDD operation with the same UL dominant static TDD UL/DL configuration
    - Option 2: All gNBs in layer 2 use dynamic TDD UL/DL assignment
* For above scenarios, the following is assumed:
  + DL dominant static TDD UL/DL configuration: {DDDSU}, where S=[12D:2G:0U]
  + UL dominant static TDD UL/DL configuration: {DSUUU}, where S=[12D:2G:0U]
  + dynamic TDD UL/DL assignment: {FFFFF}, companies to report the guard symbols assumed in their simulation

Moderator suggests **Initial proposal 1-2-1** based on the submitted proposals.

Regarding the adjacent-channel coexistence case between dynamic TDD and legacy TDD for FR1, few companies have inputs, and companies’ views are still divergent.

* Three companies [Huawei, Nokia, Spreadtrum] proposes to avoid repeating the same work as in Rel-16 unless significant parameters change.
* One company [ZTE] suggests FFS the detailed scenario for adjacent-channel coexistence case.
* One company [MediaTek] suggests several scenarios including Urban Macro, Indoor office and coexistence between HetNet and Macro.

In Moderator’s view, companies who support evaluation scenarios for adjacent-channel coexistence case should explain more on the difference (e.g., the detailed simulation assumptions) from the Rel-16 co-existence study.

### 1st Round Proposals

#### ***Initial proposal 1-2-1:***

For evaluation of dynamic/flexible TDD for the single operator case, consider the following scenarios:

* FR1
  + 1-layer scenario: Indoor office with dynamic TDD UL/DL assignment
  + 1-layer scenario: Urban Macro with dynamic TDD UL/DL assignment
  + 2-layer Scenario A
    - Layer 1: Dense Urban Macro layer
    - Layer 2: Dense Urban Micro layer
  + 2-layer Scenario B
    - Layer 1: Urban Macro
    - Layer 2: Indoor office or Indoor factory (companies to report which one is used)
      * Regarding the Indoor office layer, reuse the Indoor office (InH) scenario and relevant channel model in TR38.901.
      * Regarding the Indoor factory layer, reuse the Indoor factory (InF) scenario and relevant channel model in TR38.901.
  + Regarding 2-layer Scenario A and 2-layer Scenario B, the two layers are deployed in the same carrier
    - Layer 1 uses legacy static TDD operation with DL dominant static TDD UL/DL configuration
    - Layer 2 uses one of the following options (companies to report which option is used)
      * Option 1: All gNBs in layer 2 use legacy static TDD operation with the same UL dominant static TDD UL/DL configuration
      * Option 2: All gNBs in layer 2 use dynamic TDD UL/DL assignment
* FR2-1
  + 1-layer scenario: Indoor office with dynamic TDD UL/DL assignment
  + 1-layer scenario: Dense Urban Macro layer with dynamic TDD UL/DL assignment
* For above scenarios, the following is assumed:
  + DL dominant static TDD UL/DL configuration: {DDDSU}, where S=[12D:2G:0U]
  + UL dominant static TDD UL/DL configuration: {DSUUU}, where S=[12D:2G:0U]
  + dynamic TDD UL/DL assignment: {FFFFF}, companies to report the guard symbols assumed in their simulation

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| ZTE | We are generally supportive of the above proposal with the following comments.  1) For Indoor office vs Indoor factory, we prefer to use indoor office. Similar comment as we commented in section 2.1.3.  2) Regarding the adjacent channel, we think the main difference between Rel-16 study and Rel-18 study is that two-layer scenarios are included in Rel-18. We can be ok to focus on the above proposal without considering adjacent channel interference. But if companies have interests in including adjacent channel interference, it should not be prohibited. |
| Huawei, HiSilicon | Support. We should at least agree on the deployment scenarios for dynamic/flexible TDD for the single operation case in this meeting so that companies can start with performance evaluations for future m eetings. |
| Sony | OK with the scenarios. |
| MediaTek | Support |
| Ericsson | We support the proposal with following modifications.  Rel-16 study performed simulations for Urban Macro case with two operators in 100% grid shift and suggested that “*performance degradation was observed from the BS-to-BS interference for macro-macro scenario, which suggests that dynamic TDD should not be operated in such scenarios*.” If this was the conclusion for adjacent channel case where there is sufficient isolation between carriers in the form of ACLR/ACS, it is not clear to us the motivation to perform simulations for 1-layer scenario/2-layer scenario in the same channel that does not have such frequency isolation?  However, we notice that few companies want to perform 2-layer scenarios which are different than what was done in Rel-18 (Flexible TDD with different TDD configurations). We are not opposed to that, but we need to take a similar approach as SBFD and include a protected U slot for the dynamic TDD configuration FFFFU, so that the layer 1 that uses a legacy static TDD pattern is protected in its U slot (DDDSU) . ***Initial proposal 1-2-1:(Modified by Ericsson)*** For evaluation of dynamic/flexible TDD for the single operator case, consider the following scenarios:   * FR1   + ~~1-layer scenario: Indoor office with dynamic TDD UL/DL assignment~~   + ~~1-layer scenario: Urban Macro with dynamic TDD UL/DL assignment~~   + 2-layer Scenario A     - Layer 1: Dense Urban Macro layer     - Layer 2: Dense Urban Micro layer   + 2-layer Scenario B     - Layer 1: Urban Macro     - Layer 2: Indoor office or Indoor factory (companies to report which one is used)       * Regarding the Indoor office layer, reuse the Indoor office (InH) scenario and relevant channel model in TR38.901.       * Regarding the Indoor factory layer, reuse the Indoor factory (InF) scenario and relevant channel model in TR38.901.   + Regarding 2-layer Scenario A and 2-layer Scenario B, the two layers are deployed in the same carrier     - Layer 1 uses legacy static TDD operation with DL dominant static TDD UL/DL configuration     - Layer 2 uses one of the following options (companies to report which option is used)       * Option 1: All gNBs in layer 2 use legacy static TDD operation with the same UL dominant static TDD UL/DL configuration       * Option 2: All gNBs in layer 2 use dynamic TDD UL/DL assignment * ~~FR2-1~~   + ~~1-layer scenario: Indoor office with dynamic TDD UL/DL assignment~~   + ~~1-layer scenario: Dense Urban Macro layer with dynamic TDD UL/DL assignment~~ * For above scenarios, the following is assumed:   + DL dominant static TDD UL/DL configuration: {DDDSU}, where S=[12D:2G:0U]   + UL dominant static TDD UL/DL configuration: {DSUUU}, where S=[12D:2G:0U]   + dynamic TDD UL/DL assignment: {FFFFF}, {FFFFU}, companies to report the configuration used and the guard symbols assumed in their simulation |
| New H3C | We are fine with this proposal |
| QC | Support.  We believe that no further priotirzation is needed as it will be up to companies to submit the evaluation results for scenarios of interest of dynamic TDD. |

# Issue#2: SLS Evaluation Methodology

## Issue#2-1: Interference modelling for SBFD

### Submitted proposal

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| CMCC | ***Observation 1:*** For SLS of SBFD in RAN1, it is needed that the RSI can be scaled to RB level.  ***Proposal 4:*** For SLS of SBFD in RAN1, determine the value(s) for the RSI between DL subband to UL subband () based on the assumption of 1dB/0.8dB/0.1dB UL receiver sensitivity degradation due to self-interference of DL transmission.  ***Proposal 5:*** For SLS of SBFD in RAN1, the RSI is modeled as frequency flat within the UL subband. The gNB residual self-interference power on each receiver chain at one UL RB can be modelled as   * + is DL transmission power of gNB across all transmit chains per RB   + is the number of DL RBs scheduled for DL transmission   + is the total number of UL RBs in the UL subband   + Note: the model is based on the assumption that the same transmission power across different DL RBs are used in SLS. This does not prevent companies to use other DL power allocation schemes in SLS.   ***Proposal 6:*** For SLS in RAN1, similar method for gNB self-interference modelling can be used for co-site inter-sector co-channel inter-subband CLI modelling with different interference suppression capability.   * The starting point is that the interference suppression capability for co-site inter-sector co-channel inter-subband CLI is no smaller than the RSI value for self-interference.   ***Proposal 7:*** For SLS in RAN1, if only large scale fading is modelled and small scale fading is not modelled for gNB-gNB co-channel channel model, the inter-site gNB-gNB co-channel inter-subband CLI experienced by the victim gNB on each receiver chain at one UL RB can be modelled as   * + is the power of inter-site gNB-gNB co-channel inter-subband CLI from gNB to gNB on each receiver chain at one UL RB (linear value)   + is DL transmission power of gNB across all transmit chains per RB (linear value)   + is the number of DL RBs scheduled for DL transmission by gNB   + is the coupling loss between gNB and gNB (linear value), and analog beams of the aggressor gNB and victim gNB are also taken into account.   + is the number of RBs in the UL subband in SBFD slots   + Note: In RAN4 reply LS, gNB ACLR (i.e., ) is provided as the candidate for TX leakage, and gNB ACS (i.e., ) is provided as the candidate for Receiver impairment.   + Note: the model is based on the assumption that the same transmission power across different DL RBs are used in SLS. This does not prevent companies to use other DL power allocation schemes in SLS.   ***Proposal 8:*** For SLS in RAN1, if both large scale fading and small scale fading are modelled for gNB-gNB co-channel channel model,the inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at UL RB at victim gNB can be modeled as  where,   * + is the first part of inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at UL RB , caused by power leakage at aggressor gNB,     - is the channel matrix between aggressor gNB and victim gNB at UL RB , the analog beams of the aggressor gNB and the victim gNB can be taken into account by ,     - is the unwanted emission across all Tx chains at UL RB at aggressor gNB,       * is the number of Tx chains at aggressor gNB,       * , , is modelled as white Gaussian noise,       * is the leakage power on each Tx chain at UL RB at aggressor gNB,       * is the DL power transmitted across all Tx chains at DL RB at aggressor gNB,       * is the number of DL RBs scheduled for DL transmission by aggressor gNB,       * is the number of RBs in the UL subband in SBFD slots   + is the second part of inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at one UL RB, caused by receiver selectivity at victim gNB,     - is the channel matrix between aggressor gNB and victim gNB at DL RB , the analog beams of the aggressor gNB and the victim gNB can be taken into account by ,     - is the digital precoder at DL RB at aggressor gNB, ,     - is the symbol transmitted at DL RB at aggressor gNB.   + Note: the model is based on the assumption that the same transmission power across different DL RBs are used in SLS. This does not prevent companies to use other DL power allocation schemes in SLS.   ***Proposal 9:*** For SLS in RAN1, regarding UE-UE co-channel inter-subband CLI modelling, take in-band emission defined in TS38.101-1 and TS38.101-2 as starting point for TX model.   * FFS Rx model |
| Huawei | ***Proposal 9:*** *The gNB self-interference can be modeled as white Gaussian noise as follows:*   * *The gNB self-interference across all Rx chains at UL frequency unit can be modeled as*   *where,*   * + *is the number of Rx chains at gNB,*   + *, ,*   + *is the power of gNB self-interference on each Rx chain at UL frequency unit ,*   + *is the DL power transmitted by gNB across all Tx chains at DL frequency unit .* * *The covariance of gNB self-interference across all Rx chains at UL frequency unit can be modeled as .*   ***Proposal 10:*** *The inter-site gNB-gNB co-channel inter-subband CLI can be modeled as follows:*   * *Introduce a co-channel inter-subband leakage power ratio (ISLR) to represent the co-channel inter-subband leakage power suppression capability at gNB of aggressor.*   + *The ISLR, denoted as , can be defined as the ratio of the transmission power centered on an allocated frequency unit in a SBFD carrier to the leakage power centered on non-allocated frequency unit in the same SBFD carrier.* * *Introduce a co-channel inter-subband selectivity (ISS) to represent the co-channel inter-subband selectivity capability at gNB of victim.*   + *The ISS, denoted as , can be defined as the ratio of the receive power centered on allocated frequency unit in a SBFD carrier to the residual power suppressed by receiver selectivity centered on non-allocated frequency unit in the same SBFD carrier.* * *The inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at UL frequency unit at gNB of victim can be modeled as*   *where,*   * *is the first part of inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at UL frequency unit , caused by power leakage at gNB of aggressor,*   + *is the channel between gNB of aggressor and gNB of victim at UL frequency unit ,*   + *is unwanted emissions across all Tx chains at UL frequency unit at gNB of aggressor,*     - *is the number of Tx chains at gNB of aggressor,*     - *, , is modelled as white Gaussian noise,*     - *is the leakage power on each Tx chain at UL frequency unit at gNB of aggressor,*     - *is the DL power transmitted across all Tx chains at DL frequency unit at gNB of aggressor,* * *is the second part of inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at UL frequency unit , caused by receiver selectivity at gNB of victim,*   + *is the channel between gNB of aggressor and gNB of victim at DL frequency unit ,*   + *is the precoder at DL frequency unit at gNB of aggressor, ,*   + *is the symbol transmitted at DL frequency unit at the gNB of aggressor.* * *The covariance of inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at UL frequency unit can be modeled as*   *where,*   * *,*   + *is DL transmission power across all Tx chains at DL frequency unit at gNB of aggressor.*   ***Proposal 11:*** *The co-site inter-sector gNB-gNB co-channel inter-subband CLI can be modeled as white Gaussian noise as follows:*   * *The co-site inter-sector gNB-gNB co-channel inter-subband CLI across all Rx chains at UL frequency unit at gNB of victim can be modeled as*   *where,*   * + *is the number of Rx chains at gNB of victim,*   + *, ,*   + *is the power of co-site inter-sector gNB-gNB co-channel inter-subband CLI on each Rx chain at UL frequency unit at gNB of victim,*   + *is the DL power transmitted by gNB of aggressor across all Tx chains at DL frequency unit .* * *The covariance of co-site inter-sector gNB-gNB co-channel inter-subband CLI across all Rx chains at UL frequency unit can be modeled as .*   ***Proposal 12:*** *The UE-UE co-channel inter-subband CLI can be modeled as white Gaussian noise as follows:*   * *Introduce a UE co-channel inter-subband leakage power ratio (ISLR) to represent the co-channel inter-subband leakage power suppression capability at aggressor UE.*   + *The UE ISLR, denoted as , can be defined as the ratio of the transmission power centered on an allocated frequency unit in a SBFD carrier to the leakage power centered on a non-allocated frequency unit in the same SBFD carrier.* * *Introduce a UE co-channel inter-subband selectivity (ISS) to represent the co-channel inter-subband selectivity capability at victim UE.*   + *The UE ISS, denoted as , can be defined as the ratio of the receive power centered on a non-allocated frequency unit in a SBFD carrier to the residual power suppressed by receiver selectivity centered on an allocated frequency unit in the same SBFD carrier.* * *Introduce a UE-UE co-channel inter-subband interference ratio (ISIR), denoted as to represent both of ISLR and ISS together, which is defined as follows:* * *The UE-UE co-channel inter-subband CLI across all Rx chains at DL frequency unit at UE of victim can be modeled as*   *where,*   * + *is the number of Rx chains at UE of victim,*   + *, ,*   + *is the power of UE-UE co-channel inter-subband CLI on each Rx chain at DL frequency unit at UE of victim,*   + *is the coupling loss (linear value) between the aggressor UE and the victim UE,*   + *is the UL power transmitted by the UE of aggressor across all Tx chains at UL frequency unit .* * *The covariance of UE-UE co-channel inter-subband CLI across all Rx chains at DL frequency unit can be modeled as .*   ***Proposal 13:*** *The inter-site gNB-gNB adjacent-channel CLI can be modeled as inter-site gNB-gNB co-channel inter-subband CLI by replacing and with and , respectively, where,*   * *Adjacent-channel inter-subband leakage power ratio, denoted as , is defined as the ratio of the transmission power centered on allocated frequency unit in a SBFD carrier to the leakage power centered on non-allocated frequency unit in the adjacent SBFD carrier.* * *Adjacent-channel inter-subband selectivity, denoted as , is defined as the ratio of the receive power centered on allocated frequency unit in a SBFD carrier to the residual power suppressed by receiver selectivity centered on non-allocated frequency unit in the adjacent SBFD carrier.*   ***Proposal 14:*** *The co-site gNB-gNB adjacent-channel CLI can be modeled as co-site inter-sector gNB-gNB co-channel inter-subband CLI by replacing with* *, where,*   * *Ratio of co-site adjacent-channel CLI (RCOSITE-AC), denoted as , is defined as the ratio of the total power transmitted by a gNB of aggressor across all Tx chains on a frequency unit in a SBFD carrier to the residual interference received by a gNB of victim on a single Rx chain at a different frequency unit in the adjacent SBFD carrier.*   ***Proposal 15:*** *The UE-UE adjacent-channel CLI can be modeled as UE-UE co-channel inter-subband CLI by replacing the UE-UE ISIR with the ACIR.* |
| Ericsson | Proposal 22: RAN1 to agree that gNB self-interference (RSI) is modelled as frequency flat.  Proposal 23: RAN1 to further agree that the overall RSIC value ranges provided by RAN4 is a net effect relative PSD interference metric with certain assumptions on the wanted carrier and the adjacent carrier bandwidths for the 40-20-40 SBFD configuration in FR1.  Proposal 24: RAN1 to agree that for SLS purposes, the interference model assumes that the transmission power PSD is constant for all transmissions across different DL RBs and slots.  Proposal 25: RAN1 to agree to use average DL PSD, that is calculated as the actual transmit power in allocated DL RBs averaged over the total number of DL RBs, to estimate the interference PSD.   * 1. An example self-interference cancellation for Urban Macro in FR1 is shown below  * + 1. , this is the total transmit power per DL subband.  * + 1. 10\*log10() This is the Average power per RB, that needs to be kept the same/constant for all slots and RB allocations.     2. Allocate *N* DL RBs to be used for transmissions.     3. Calculate the Actual Tx Power in the DL RBs as = 10\*log10() , which is dependent on the total number of allocated RBs.     4. Calculate Average DL PSD per RB as Actual Tx power in DL RBs/ total number of RBs 10\*log10() .     5. ,        1. where = 80 dBc(antenna isolation) + 45 dBc(frequency isolation)+15 dBc(digital IC). |
| Samsung | *Proposal 8: For self-interference modeling, the starting point is the RSI capability resulting the residual self-interference level of 1 dB*  *Proposal 9: For co-site inter-sector co-channel inter-subband CLI* *modeling, reuse the self-interference modeling with different SI suppression capability.*   * *The starting point is to the SI suppression capability for co-site inter-sector co-channel inter-subband CLI is no smaller than the SI suppression capability for self-interference.*   *Proposal 10: RAN1 to agree the following UE-gNB co-channel intra-subband interference modeling at RB m,*  *where*   * *iUE, and NUE are the aggressor UE index and the number of aggressor UEs, respectively* * *is the received interference signal power from the aggressor UE iUE from RB m, denoted as*    + - *is total transmit power of aggressor UE iUE in dB scale*     - *is pathloss (or coupling loss) of aggressor UE iUE in dB scale*     - *is the number of scheduled RBs of aggressor UE iUE* * *is the effective channel from aggressor UE iUE at RB m, can be decomposed of*    + - *is the wireless channel matrix from aggressor UE iUE at RB m (including analog beamforming), and denote # of RX chains at the victim gNB and # of TX chains at aggressor UE, respectively*     - *is the digital beamforming matrix used at aggressor UE iUE at RB m, denotes # of layers at aggressor UE iUE.*   *Proposal 11: RAN1 to agree the following inter-site gNB-gNB co-channel inter-subband CLI modeling at RB m,*  *where*   * *iBS, and NBS are the aggressor BS index and the number of aggressor BSs, respectively* * *q and Q(iBS) are the scheduled DL RB index and the number of scheduled DL RBs of aggressor BS iBS, respectively* * *is the received interference signal power from the aggressor BS iBS from DL RB q, denoted as*    + - *is total transmit power of aggressor BS iBS in dB scale*     - *is pathloss (or coupling loss) of aggressor BS iBS in dB scale*     - *is the total number of DL RBs in DL subband* * *is the effective channel from aggressor BS iBS at RB m, can be decomposed of*    + - *is the wireless channel matrix from aggressor gNB iBS at RB m (including analog beamforming)*     - *is the digital beamforming matrix used at aggressor gNB iBS at RB m.*        * *If RB m is UL RB in UL subband, is chosen as the normalized identity matrix with unit norm.*       * *Otherwise (If RB m is DL RB in DL subband), is derived at aggressor gNB iBS by considering gNB-UE channel of the scheduled UE(s) in aggressor gNB iBS*   *Proposal 12: For gNB-gNB adjacent-channel* *CLI modeling, reuse the followings*   * *For co-site gNB-gNB adjacent-channel CLI modeling, reuse the self-interference modeling with different SI suppression capability*   + *The starting point is to antenna isolation value for co-site gNB-gNB adjacent-channel modeling is no smaller than that for co-site inter-sector co-channel inter-subband CLI and self-interference.*   + *No digital SIC value for co-site gNB-gNB adjacent-channel modeling* * *For inter-site gNB-gNB adjacent-channel CLI modeling, reuse the* *inter-site gNB-gNB co-channel inter-subband CLI with different gNB ACLR and gNB ACS values*   + *The starting point is to the gNB ACLR and gNB ACS for inter-site gNB-gNB adjacent-channel CLI modeling is no smaller than the SI suppression capability for the* *inter-site gNB-gNB co-channel inter-subband CLI.*   *Proposal 13: RAN1 to agree the following gNB-UE co-channel intra-subband interference at RB n,*  *where*   * *iBS, and NBS are the aggressor BS index and the number of aggressor BSs, respectively* * *is the received interference signal power from the aggressor BS iBS from RB n, denoted as*    + - *is total transmit power of aggressor BS iBS in dB scale*     - *is pathloss (or coupling loss) of aggressor BS iBS in dB scale*     - *is the number of DL RBs in DL subband* * *is the effective channel from aggressor BS iBS at RB n, can be decomposed of*    + - *is the wireless channel matrix from aggressor BS iBS at RB n (including analog beamforming)*     - *is the digital beamforming matrix used at aggressor BS iBS at RB n*   *Proposal 14: RAN1 to agree the following UE-UE co-channel inter-subband CLI* *modeling at RB n,*  *where*   * *iUE, and NUE are the aggressor UE index and the number of aggressor UEs, respectively* * *v and V(iUE) are the scheduled RB index and the number of scheduled RBs of aggressor UE iUE, respectively* * *is the received interference signal power from the aggressor UE iUE from RB v, denoted as*    + - *is total transmit power of aggressor UE iUE in dB scale*     - *is pathloss (or coupling loss) of aggressor UE iUE in dB scale* * *is the effective channel from aggressor UE iUE at RB m, can be decomposed of*    + - *is the wireless channel matrix from aggressor UE iUE at RB n (including analog beamforming)*     - *is the digital beamforming matrix used at aggressor UE iUE at RB n.* * represents TX leakage from RB *v* to RB *n* modelled by UE’s in-band emission (IBE) value in linear scale (see TS38.101-1 or TS38.101-2) , * FFS: represents RX impairment from RB *v* to RB *n* modelled by UE ACS value per RB in linear scale,   *Proposal 15: For UE-UE adjacent-channel* *CLI modeling, reuse the UE-UE co-channel inter-subband CLI* *modeling by replacing with UE ACLR per RB* |
| Qualcomm | **Proposal 23: Consider the following values for RSI**   * **FR1: baseline (140 dBc) and advanced 155 dBc**    + **80 dB (spatial) + 45 dB (freq) + 15~30 (Digital IC)** * **FR2: baseline (125 dBc) and advanced of 153 dBc**   + **80-95 dB (spatial) + 25~28 dB (freq.) + 20-30 (Digital IC)**   **Observation 12: based on our FR2 measurements:**   * **Inter subband ACLR is frequency dependent, the farther on the frequency band, the less ACLR.** * **Far field inter subband ACLR has dependency on beam directionality.**   **Proposal 24: The RSI is modelled as frequency flat (i.e., fixed value) within the UL-SB.**   * **The per-RB RSI can be represented as:**   **Proposal 25: There is no need to model the effect of RSI on gNB receiver blocking and AGC.**   * **Inband blocking requirements achieves required selectivity to avoid gNB receiver blocking** * **AGC modeling is not feasible in SLS.**   **Proposal 26: RAN1 to consider same method log of self-interference (RSI) to model co-site inter-gNB CLI with different parameters of spatial isolation.**  **Proposal 27: RAN1 to consider ACLR and ACS for inter-site inter-SB CLI modelling at gNB Tx and gNB Rx respectively.**  **Proposal 28: RAN1 to consider an equivalent simpler model for UE Tx leakage modeling based on RAN4 IBE requirement. (e.g. equivalent flat model based on worst case IBE)**  **Proposal 29: RAN1 to assumes no UE in-band selectivity when modelling the effect Aspect 2.**  **Proposal 30: For co-site inter-sector adjacent channel CLI modeling, RAN1 to hold on the discussion until RAN4 discussion concludes on the recommended alternative for CLI modeling.**  **Proposal 31: For adjacent channel inter-stie inter-gNB CLI modelling, adopt similar model of co-channel inter-gNB CLI co-channel based on assumptions of ACLR and ACS.**  **Proposal 32: For adjacent channel inter-UE CLI modelling, adopt same ACIR model as Rel-16 CLI study as starting point based on UE ACLR on TX and UE ACS on RX.**  **Observation 13: The amount of residual self-interference depends on gNB spatial isolation, subband frequency isolation, digital interference cancellation and beamform nulling/isolation.**  **Proposal 33: The residual self-interference at gNB receiver is modelled as fixed value across the UL subband and is given by**   * **where is the overall self-inference reduction capability of the gNB by means of spatial isolation, subband frequency isolation, digital interference cancellation and beamform nulling/isolation.** * **In SLS, the leakage in UL subband can be modeled as gaussian noise with zero mean and power**   **Observation 14: There is no 3GPP model for clutter modelling.**  **Observation 15: Exact clutter modelling is complicated and may drain RAN1 time and efforts.**  **Observation 16: A statistical clutter model based on statistics of clutter strength and AoA is simple model.**  **Proposal 34: At least for FR2, for subband full duplex deployment scenario, simplified statistical clutter modelling can be considered based on statistics of cluster power and AoA.**  **Proposal 35: For subband full duplex deployment scenario, simplified statistical clutter modelling shall be intra-serving-gNB model and shall have no impact on other gNBs and UEs in the network.**  **Observation 17: RAN1 needs to agree on the inter-subband cross-link interference model for subband full duplex evaluation.**  **Proposal 36: The leakage interference at the UL subband of the victim gNB can be obtained by applying the gNB-gNB channel model on the Tx non-linear leakage Zk at the aggressor gNB Tx in the UL subband.**   * **The power of NL Tx leakage power is given by gNB Tx power and ACLR values** * **The Zk = W gk where gk is gaussian noise with zero mean and leakage power, and W is FFS**   **Observation 18: It is important to consider both large-scale and small-scale fading’s when modelling the inter-gNB channel and CLI to get accurate modelling of the spatial beamforming gains or nulls.**  **Proposal 27:­ For proper modelling of inter-gNB channel and CLI, consider both large-scale and small-scale for both component of the DL-Tx and DL-NL.**  **Proposal 38:**­ **The assumed spatial isolations between the sectors in one site should be better than self-interference spatial isolation as the sectors are further apart, have different direction and possibility of improved site isolation (e.g. in-between sectors).**  **Observation 19**­ **Whether to consider digital IC for co-siter inter-sector interference mitigation depends on gNB capability and trade-off for gNB energy savings.**  **Proposal 39:**­ **For co-site inter-sector gNB-gNB CLI modeling, the leakage interference in victim gNB receiver is modeled as fixed value.**   * **The leakage power is given by** * **In SLS, the leakage in UL subband can be modeled as gaussian noise with zero mean and power** * **The co-site spatial isolation for FR1 and FR2 is given in the table below** * **FFS: digital IC capability depending on advanced gNB capability and Energy savings trade-off**   **Proposal 40: For inter-UE inter-subband CLI modeling, the leakage interference at the DL subband of the victim UE can be obtained by applying the UE-UE channel model on the Tx non-linear leakage Zk at the aggressor UE Tx in the DL subband.**   * **The power of NL Tx leakage power is given by UE Tx power and IBE values,** * **The Zk = W gk where gk is gaussian noise with zero mean and leakage power, and W is wideband precoder.**   **Proposal 41: For inter-UE inter-subband CLI modeling, the blocker interference at the UL subband of the victim UE can be modelled as increase of quantization noise which affects the DL SIQRN when blocker power is higher than RSSI of the DL signal.** |
| Nokia | **Proposal 6: Study the effect of non-linearities at the gNB receiver, and introduce NF increase model into SLS evaluation where the model defines NF increase as a function of peak input power. Use following piece-wise linear approximation with the parameter (*a*, *b*, SL1, SL2) as baseline, where the first and the second input threshold are *a* and *b,* with the slopes SL1 and SL2, respectively. Parameters of the model (*a*, *b*, SL1, SL2) can be further discussed in RAN1 or based on RAN4’s input.** |
| CATT | **Proposal 8: Adopt ACIR defined in Table 1 for case 4.** |
| Xiaomi | **Observation 3: For deployment case 2, the following two interference type should be take into account:**   * **gNB-UE co-channel inter-subband interference: Interfernece caused by DL transmission of the aggressor gNB on a first set of RBs in a carrier to DL reception of the victim UE on a second set of RBs in the same carrier, where the two RB sets are non-overlapping in frequency.** * **UE-gNB co-channel inter-subband interference: Interfernece caused by UL transmission of the aggressor UE on a first set of RBs in a carrier to UL reception of the victim gNB on a second set of RBs in the same carrier, where the two RB sets are non-overlapping in frequency.** |
| Spreadtrum | ***Observation 1: The value range of RSIC given by RAN4 LS will be used for gNB self-interference model and the granularity is sub-band. The impacts of receiver imperfections, blocking, AGC, gNB antenna architecture, and the beam will be further evaluated in the self-interference model after the evaluation results obtained from RAN4.***  ***Proposal 15: The RSI-like model and ACLR and ACS models are adopted for modeling gNB-gNB co-channel inter-subband CLI in the co-site scenario and inter-site scenario, respectively. The granularity of the gNB-gNB inter-subband CLI model should be at least the sub-band.***  ***Proposal 16: For UE-UE co-channel inter-subband CLI, the in-band emission and the maximum input power are considered for modeling the transmitter leakage and receiver impairment, respectively, before further study results are achieved in RAN4.***  ***Proposal 17: For gNB-gNB and UE-UE adjacent-channel CLI modelling, ACLR and ACS based models could be the starting point for evaluating the adjacent-channel CLI.*** |

### Summary

#### **gNB Self-Interference**

Ericsson suggests RAN1 to further agree that the overall RSIC value ranges provided by RAN4 is a net effect relative PSD interference metric with certain assumptions on the wanted carrier and the adjacent carrier bandwidths for the 40-20-40 SBFD configuration in FR1. CMCC suggests RAN1 to assume the overall RSIC value ranges provided by RAN4 as the RSI between DL subbands and UL subband based on certain SBFD subband configuration with {DUD}.

Moderator suggests **Initial proposal 2-1-1** based on the submitted proposals.

Regarding how to determine the candidate value(s) for RSI,

* Some companies [e.g., Samsung, CMCC] suggest the candidate values for RSI can be determined based on the assumption of 1dB/0.8dB/0.1dB UL receiver sensitivity degradation due to self-interference of DL transmission.
* Some companies [e.g., Qualcomm] suggests to consider some specific values for RSI, e.g.,
  + FR1: baseline (140 dBc) and advanced 155 dBc
    - 80 dB (spatial) + 45 dB (freq) + 15~30 (Digital IC)
  + FR2: baseline (125 dBc) and advanced of 153 dBc
    - 80-95 dB (spatial) + 25~28 dB (freq.) + 20-30 (Digital IC)

Moderator suggests **Initial proposal 2-1-2** based on the submitted proposals.

Some companies [Ericsson, Qualcomm, Spreadtrum, CMCC] suggest that RSI can be modelled as frequency flat within the UL subband. CMCC observes that, from RAN1 SLS perspective, it is needed that the RSI can be scaled to RB level, since in a specific SBFD slot, not all the DL RBs are always occupied for DL transmission and not all the UL RBs are always occupied for UL reception. Some companies [e.g., Huawei, Ericsson, Qualcomm, Samsung, CMCC] propose the detailed gNB self-interference modeling. Some of them [e.g., Huawei, Qualcomm, CMCC] suggest to model the residual gNB self-interference as white Gaussian noise.

Moderator suggests **Initial proposal 2-1-3** based on the submitted proposals.

#### **Co-site inter-sector co-channel inter-subband CLI**

Some companies [e.g., Samsung, Qualcomm, Spreadtrum, CMCC] suggest to reuse the gNB self-interference modeling for co-site inter-sector co-channel inter-subband CLI modelling with different interference suppression capability, e.g., the starting point is that the interference suppression capability for co-site inter-sector co-channel inter-subband CLI is no smaller than the RSI value for self-interference. Some companies [e.g., Huawei, CMCC] suggest that the co-site inter-sector co-channel inter-subband CLI can be modelled as white Gaussian noise.

Moderator suggests **Initial proposal 2-1-4** based on the submitted proposals.

#### **Inter-site gNB-gNB co-channel inter-subband CLI**

Some companies [e.g., Qualcomm, Spreadtrum] suggest RAN1 to consider ACLR and ACS for inter-site gNB-gNB co-channel inter-subband CLI modelling at gNB Tx and gNB Rx respectively. Some companies [e.g., Huawei, Samsung, Qualcomm, CMCC] propose the detailed inter-site gNB-gNB co-channel inter-subband CLI modeling considering both large scale fading and small scale fading. Some companies [e.g., CMCC] also propose the detailed inter-site gNB-gNB co-channel inter-subband CLI modeling only considering large scale fading.

Moderator suggests **Initial proposal 2-1-5 and 2-1-6** based on the submitted proposals.

#### **UE-UE co-channel inter-subband CLI**

In RAN1#109-e meeting, agreement was achieved on UE-UE co-channel inter-subband CLI.

|  |
| --- |
| Agreement  For discussion of gNB-gNB and UE-UE co-channel inter-subband CLI modelling in system level simulation, RAN1 understands at least the following two aspects need to be considered:   * **Aspect 1:** The unwanted emissions due to Tx non-linearity at the transmitter of the aggressor from the allocated RBs to the non-allocated RBs in the same carrier. * **Aspect 2:** The receiver selectivity at the victim to receive the desired signal in the allocated RBs in the presence of the unwanted signals at the non-allocated RBs. (e.g. receiver blocking at the victim, overload of the receiver dynamic range, etc) |

Regarding the Aspect 1 for UE-UE co-channel inter-subband CLI modelling,

* Some companies [e.g., Samsung, Spreadtrum, CMCC] suggest to take in-band emission (IBE) defined in TS38.101-1 and TS38.101-2 as starting point for TX model.
* Qualcomm suggests to consider an equivalent simpler model for UE Tx leakage modeling based on RAN4 IBE requirement. (e.g. equivalent flat model based on worst case IBE)

Regarding the Aspect 2 for UE-UE co-channel inter-subband CLI modelling,

* Qualcomm suggests to model the blocker interference at the UL subband of the victim UE as increase of quantization noise which affects the DL SIQRN when blocker power is higher than RSSI of the DL signal.
* Spreadtrum suggests to consider the maximum input power for modeling the receiver impairment before further study results are achieved in RAN4.
* Some companies [e.g., Samsung] suggests to use UE ACS for the Rx model for evaluation.

Some companies [e.g, Huawei, Samsung] propose the detailed UE-UE co-channel inter-subband CLI modelling.

Moderator suggests **Initial proposal 2-1-7** based on the submitted proposals.

#### **Inter-site gNB-gNB adjacent-channel CLI**

Some companies [e.g., Huawei, Samsung, Qualcomm] suggest to reuse the inter-site gNB-gNB co-channel inter-subband CLI modelling for Inter-site gNB-gNB adjacent-channel CLI with gNB ACLR and gNB ACS values. Spreadtrum suggests that ACLR and ACS based models could be the starting point for evaluating the Inter-site gNB-gNB adjacent-channel CLI.

Moderator suggests **Initial proposal 2-1-8** based on the submitted proposals.

#### **Co-site gNB-gNB adjacent-channel CLI**

Some companies [e.g., Huawei, Samsung] suggest, for co-site gNB-gNB adjacent-channel CLI, reuse similar method as co-site inter-sector co-channel inter-subband CLI modeling with different interference suppression capability.

* The starting point is the antenna isolation value for co-site gNB-gNB adjacent-channel modeling is no smaller than that for co-site inter-sector co-channel inter-subband CLI.
* No digital SIC value for co-site gNB-gNB adjacent-channel CLI modeling.

Qualcomm suggests to hold on the discussion for co-site gNB-gNB adjacent-channel CLI until RAN4 discussion concludes on the recommended alternative for CLI modeling.

#### **UE-UE adjacent-channel CLI**

Some companies [e.g., Huawei, Samsung] suggest to reuse the UE-UE co-channel inter-subband CLI for UE-UE adjacent-channel CLI with ACLR/ACIR. Some companies [Qualcomm, Spreadtrum] suggests to adopt the same ACIR model as Rel-16 CLI study as starting point based on UE ACLR on TX and UE ACS on RX.

Moderator suggests **Initial proposal 2-1-9** based on the submitted proposals.

#### **Other**

Qualcomm suggests, at least for FR2, for subband full duplex deployment scenario, simplified statistical clutter modelling can be considered based on statistics of cluster power and AoA.

Nokia suggests to study the effect of non-linearities at the gNB receiver, and introduce NF increase model into SLS evaluation where the model defines NF increase as a function of peak input power

### 1st Round Proposals

#### ***Initial proposal 2-1-1:***

RAN1 assume the overall RSI value ranges provided by RAN4 are based on the assumption of SBFD subband configuration with {DUD=40MHz:20MHz:40MHz} for FR1 and SBFD subband configuration with {DUD=40MHz:20MHz:40MHz} for FR2.

* Based on this assumption, use to denote the overall RSI value provided by RAN4, which can be understood as the ratio of the total power transmitted by gNB across all transmit chains on the two DL subbands in a SBFD carrier to the residual self-interference received by the same gNB on a single receiver chain on the UL subband in the same SBFD carrier.
* Send LS to RAN4 to confirm RAN1’s understanding

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We are ok to ask RAN4’s feedback on this aspect. |
| Huawei, HiSilicon | Support. |
| Sony | OK to clarify. |
| Ericsson | We support the proposal with following modifications. - RSI has many components, out of which only the frequency isolation is frequency/BW configuration dependent. Therefore, it might be better to isolate the discussion only to that component: Frequency isolation. For instance, we think that the 45 dBc for the frequency isolation in FR1 stems from the ACLR requirement for FR1. The ACLR RF requirement is defined with equal wanted signal and adjacent channel bandwidths.  It is not clear to us if for FR2 the same configuration 40-20-40 was used, because the frequency isolation values for FR2 is a range 22.5 dBc ~30 dBc while it is a fixed value of 45 dBc for FR1. so, we propose the following modifications. ***Initial proposal 2-1-1:*** RAN1 assumes the frequency isolation values in the overall RSI value ranges provided by RAN4 are based on the assumption of SBFD subband configuration with {DUD=40MHz:20MHz:40MHz} at least for FR1. ~~and SBFD subband configuration with {DUD=40MHz:20MHz:40MHz} for FR2.~~   * Based on this assumption, use to denote the overall RSI value provided by RAN4, which can be understood as the ratio of the total power transmitted by gNB ~~across all transmit chains~~ on the two DL subbands in a SBFD carrier to the residual self-interference received by the same gNB ~~on a single receiver chain~~ on the UL subband in the same SBFD carrier. * Send LS to RAN4 to confirm RAN1’s understanding on the frequency isolation values for FR1 and the subband configuration assumed for FR2 |
| New H3C | We are fine with this proposal |
| QC | Generally okay to confirm than these numbers are for 100MHz for both FR1 and FR2 with assumption of full allocations of DL in the DL-SB under maximum Tx Power. |

#### ***Initial proposal 2-1-2:***

For SLS of SBFD in RAN1, determine candidate values for based on the assumption that UL receiver sensitivity degradation due to self-interference is 1dB, 0.8dB and 0.1dB, respectively.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We are fine with the direction of determining candidate values for based on the assumption that UL receiver sensitivity degradation. However, currently, based on the following bullets from RAN4 LS, RAN4 only agrees using 1dB sensitivity degradation as the starting point and other values are pending on the feasibility study.   * + 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.   Thus, we propose the following update.  **Updated proposal:**  *For SLS of SBFD in RAN1, determine candidate values for based on the assumption that UL receiver sensitivity degradation due to self-interference is 1dB~~, 0.8dB and 0.1dB, respectively~~.*   * *FFS: UL receiver sensitivity degradation due to self-interference is 0.8dB and 0.1dB* |
| Huawei, HiSilicon | Fine in general and also support ZTE to take 1dB receiver sensitivity degradation as baseline. |
| Sony | We share similar views with ZTE, i.e. we should first consider the 1 dB degradation suggested by RAN4. |
| Ericsson | We unfortunately cannot support this proposal.  We can estimate the receiver sensitivity degradation due to self-interference based on the realistic and feasible values assumed for various isolation and interference cancellation values (Antenna isolation, frequency isolation, self-interference cancellation etc. ). However, assuming a sensitivity degradation and then reverse-engineering the numbers needed for isolation and self-interference cancellation does not provide any insights into the actual feasibility of achieving those numbers for isolation. |
| New H3C | We are fine with this proposal with ZTE’s modification |
| QC | We are okay with that approach as well.  However, it will be good to provide the framework how to compute either the value of or how to compute the value of the residual self-interference in dBm based on the target UL receiver sensitivity, DL Tx Power, NF and UL-SB bandwidth.   * For example, for sensitivity of 0.1 dB, the residual self-interference should be 10 dB below the noise floor. Then assuming 20MHz UL-SB and 5dB NF, the thermal noise floor is given by = -174 + 10\*log10 (20e6) + 5 = -96 dBm. Then, the residual self-interference is -106 dBm. The value of |

#### ***Initial proposal 2-1-3:***

For SLS of SBFD in RAN1, the gNB residual self-interference can be modelled as white Gaussian noise, and the RSI is modelled as frequency flat within the UL subband.

* The gNB residual self-interference power on each receiver chain at one UL RB can be modelled as
  + - is DL transmission power of gNB across all transmit chains per RB
    - is the number of DL RBs scheduled for DL transmission
    - is the total number of UL RBs in the UL subband
    - Note: the model is based on the assumption that the same transmission power across different DL RBs are used in SLS. This does not prevent companies to use other DL power allocation schemes in SLS.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | Overall, we are fine with this proposal with the following comments.  From our perspective, the main information of this proposal is to confirm “frequency flat within the UL subband” and calculate residual self-interference power at each UL RB. It seems “*the gNB residual self-interference can be modelled as white Gaussian noise*” is not necessary in the main bullet. We can assume the same interference over all these Rx chains for simplicity. |
| Huawei, HiSilicon | Support. |
| Ericsson | We understand and support the FL’s intention /motivation for the proposal. However, we also agree with ZTE’s comments and have the following comments.   * + - 1. We also think that gNB residual interference need not be modelled as a white Gaussian noise, but it simply can be assumed to have the same interference over all the Rx chains.       2. According to our understanding and as mentioned in 2.1.1, in our opinion the ACLR (frequency isolation component) is calculated based on the assumption that . Therefore, we could also do this based on our proposal 25 by replacing with .   + In our implementation, it would be the interference if there would be a DL on one side with 20MHz BW and counting the power in that 20MHz only. Therefore, for this case it is assuming that power shared across 2\*40 MHz DL subbands has the same impact as if the full power is put into an adjacent 20 MHz channel. |
| New H3C | Support |
| QC | Generally fine with the direction of the proposal. However, we have few things to clarify in this proposal: The assumption is DL transmission should be constant EPRE (i.e the per-RB power is fixed, and total power depends on number of allocated DL RBs).is computed based on the maximum TxPower (e.g. 49 dBm for UMa) and full DL allocation, e.g. 100MHz or 80MHzOur understanding from RAN4 reply LS is that only the frequency isolation is derived based on full downlink allocations and values is based on ACLR. In that regard, the scaling factor should be based on #**RBs in the DL.** Then, it may be better to discuss first how to compute the total leakage power in the UL subband and its model (i.e. frequency flat). Then, we can discuss how it can be scaled per-RB. |

#### ***Initial proposal 2-1-4:***

For SLS in RAN1, for co-site inter-sector co-channel inter-subband CLI modelling, reuse similar method as gNB self-interference modelling with different interference suppression capability.

* The starting point is that the interference suppression capability for co-site inter-sector co-channel inter-subband CLI is no smaller than the RSI value for self-interference.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We are generally fine with this proposal. However, from our perspective, the starting point is to align companies’ simulation assumptions. It is better to change it to the following.   * *The starting point is that the interference suppression capability for co-site inter-sector co-channel inter-subband CLI is the same as ~~no smaller than~~ the RSI value for self-interference.* |
| Huawei, HiSilicon | Support. |
| Sony | Support.  We would expect the interference suppression to be higher in co-site compared to self-interference. |
| Ericsson | We do not support the proposal in its current form.  The modelling for co-site inter-sector needs to be taken separately with realistic assumptions and feasibility aspects for inter-sector isolation. Our simulation results suggest huge impact in the performance due to inter-sector interference. ***Initial proposal 2-1-4:*** For SLS in RAN1, for co-site inter-sector co-channel inter-subband CLI modelling, ~~reuse~~ similar method as gNB self-interference modelling with different interference suppression capability can be considered.   * ~~The starting point is that the interference suppression capability for co-site inter-sector co-channel inter-subband CLI is no smaller than the RSI value for self-interference.~~ |
| New H3C | Support |
| QC | Support |

#### ***Initial proposal 2-1-5:***

For SLS in RAN1, if only large scale fading is modelled and small scale fading is not modelled for gNB-gNB co-channel channel model, the inter-site gNB-gNB co-channel inter-subband CLI experienced by the victim gNB on each receiver chain at one UL RB can be modelled as

* + is the power of inter-site gNB-gNB co-channel inter-subband CLI from gNB to gNB on each receiver chain at one UL RB (linear value)
  + is DL transmission power of gNB across all transmit chains per RB (linear value)
  + is the number of DL RBs scheduled for DL transmission by gNB
  + is the coupling loss between gNB and gNB (linear value), and analog beams of the aggressor gNB and victim gNB are also taken into account.
  + is the number of RBs in the UL subband in SBFD slots
  + Note: In RAN4 reply LS, gNB ACLR (i.e., ) is provided as the candidate for TX leakage, and gNB ACS (i.e., ) is provided as the candidate for Receiver impairment.
  + Note: the model is based on the assumption that the same transmission power across different DL RBs are used in SLS. This does not prevent companies to use other DL power allocation schemes in SLS.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We support this proposal. |
| Huawei, HiSilicon | We understand the intention of the proposal is to simply the simulation complexity. However, ur view is that only considering large scale fading in the inter-site gNB-gNB co-channel inter-subband CLI modeling is not reasonable. As shown in our contribution, if we only consider the large-scale fading, the gNB-gNB non-linear interference and the gNB blocking interferences become Gaussian white noise. Obviously, this does not reflect the reality that these interferences have the directionality.  On the other hand, if we only consider the large scale fading of gNB-gNB channel for the CLI modeling, the potential space domain technologies cannot be used and properly evaluated to suppress the interference, such as coordinated beamforming, advanced receivers, etc. According to our evaluations, both mean UL Average-UPT and 5% UL Average-UPT of the simulation cases only considering the large scale fading of gNB-gNB channel are much lower than that of the simulation cases considering both large scale fading and fast fading of gNB-gNB channel, where IRC receiver is used to suppress both of legacy interference and CLI, as follows.  Therefore, wo do not support to only consider large scale fading to model the inter-site gNB-gNB co-channel inter-subband CLI. |
| Sony | Fine with the proposal. |
| MediaTek | We suggest adding a note that the ACLR/ACS model is applicable to the RBs beyond the guardband (i.e., it is not applicable to the RBs in the guardband). |
| Ericsson | We understand the intention of the proposal, but we have same comments as 2-1-4. |
| New H3C | Support |
| QC | Similar comments as ones provided in 2-1-3   * Clarify how is computed (similar to earlier comment) * The scaling (per-RB interference power) should be based on #RBs in DL. |

#### ***Initial proposal 2-1-6:***

For SLS in RAN1, if both large scale fading and small scale fading are modelled for gNB-gNB co-channel channel model, the inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at UL RB at victim gNB can be modeled as

where,

* is the first part of inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at UL RB , caused by power leakage at aggressor gNB,
  + is the channel matrix between aggressor gNB and victim gNB at UL RB , the analog beams of the aggressor gNB and the victim gNB can be taken into account by ,
  + is the unwanted emission across all Tx chains at UL RB at aggressor gNB,
    - is the number of Tx chains at aggressor gNB,
    - , , is modelled as white Gaussian noise,
    - is the total leakage power at UL RB at aggressor gNB,
    - is the DL power transmitted across all Tx chains at DL RB at aggressor gNB,
    - is the number of DL RBs scheduled for DL transmission by aggressor gNB,
    - is the number of RBs in the UL subband in SBFD slots
  + is the normalized identity matrix with unit norm, ,
    - FFS whether can be other values and corresponding conditions
* is the second part of inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at one UL RB, caused by receiver selectivity at victim gNB,
  + is the channel matrix between aggressor gNB and victim gNB at DL RB , the analog beams of the aggressor gNB and the victim gNB can be taken into account by ,
  + is the digital precoder at DL RB at aggressor gNB, ,
  + is the symbol transmitted at DL RB at aggressor gNB.
* Note: In RAN4 reply LS, gNB ACLR (i.e., ) is provided as the candidate for TX leakage, and gNB ACS (i.e., ) is provided as the candidate for Receiver impairment.
* Note: the model is based on the assumption that the same transmission power across different DL RBs are used in SLS. This does not prevent companies to use other DL power allocation schemes in SLS.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We are supportive to consider both the large scale and small scale in the interference model. However, we have the following detailed comments.   * Comment#1: For simplicity, we can assume the same interference levels among all the Rx chains instead of assuming Gaussian noise. * Comment#2: It seems the W in the calculation is not necessary. Could you clarify the function of W here?   Overall, we propose the following update.   * is the first part of inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at UL RB , caused by power leakage at aggressor gNB,   + is the channel matrix between aggressor gNB and victim gNB at UL RB , the analog beams of the aggressor gNB and the victim gNB can be taken into account by ,   + is the unwanted emission across all Tx chains at UL RB at aggressor gNB,     - is the number of Tx chains at aggressor gNB,     - , , ~~is modelled as white Gaussian noise,~~     - is the total leakage power at UL RB at aggressor gNB,     - is the DL power transmitted across all Tx chains at DL RB at aggressor gNB,     - is the number of DL RBs scheduled for DL transmission by aggressor gNB,     - is the number of RBs in the UL subband in SBFD slots   + is the normalized identity matrix with unit norm, ,     - FFS whether can be other values and corresponding conditions |
| Huawei, HiSilicon | Support in principle.  Minor update highlighted below:  ***Initial proposal 2-1-6:*** For SLS in RAN1, if both large scale fading and small scale fading are modelled for gNB-gNB co-channel channel model, the inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at UL RB at victim gNB can be modeled as  where,   * is the first part of inter-site gNB-gNB co-channel inter-subband CLI across all Rx chains at UL RB , caused by power leakage at aggressor gNB,   + is the channel matrix between aggressor gNB and victim gNB at UL RB , the analog beams of the aggressor gNB and the victim gNB can be taken into account by ,   + is the unwanted emission across all Tx chains at UL RB at aggressor gNB,     - is the number of Tx chains at aggressor gNB,     - , , is modelled as white Gaussian noise,     - is the total leakage power at UL RB at aggressor gNB,     - is the DL power transmitted across all Tx chains at one DL RB at aggressor gNB,     - is the number of DL RBs scheduled for DL transmission by aggressor gNB,     - is the number of RBs in the UL subband in SBFD slots   + is the normalized identity matrix with unit norm, ,     - FFS whether can be other values and corresponding conditions |
| Ericsson | We understand the intention of the proposal, but we have same comments as 2-1-4. |
| New H3C | Fine with HW’s modification |
| QC | Similar comment on how to compute the leakage power at Tx gNB based on #RB in DL SB. For the interference in the DL-SB, it is sufficient to model it per RB |

#### ***Initial proposal 2-1-7:***

For SLS in RAN1, regarding UE-UE co-channel inter-subband CLI modelling, take in-band emission (IBE) defined in TS38.101-1 and TS38.101-2 as starting point for TX model.

* FFS Rx model

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | In order to simulate UE-UE co-channel inter-subband CLI, both Tx model and Rx model. Currently, RAN4 only defines starting point for Tx model. The Rx model is still FFS. From this point, the current proposal is not urgent, we propose to wait until RAN4 has defined the Rx model so that we can have a full picture of this UE-UE co-channel inter-subband CLI modelling. |
| Huawei, HiSilicon | We are fine to use IBE for the Tx model. |
| MediaTek | We support the proposal. We don’t see a need delay the discussion on the Tx model just because the Rx model is not provided yet by RAN4. |
| Ericsson | We support this proposal. |
| New H3C | Support |
| QC | We prefer to have a simpler model for IBE, e.g., an equivalent flat model as shown below figure.    In addition, given there is no requirement for UE in-band (i.e. in-channel) selectivity, there is no protection for blocking of the AGC due to strong inter-UE CLI. This needs to be further studied on how it affects the UE dynamic range and quantization of the target DL signal. One model is provided in our tdoc [24] to reflects the impact of CLI with increased quantization noise when CLI is higher than RSSI of DL signal. |

#### ***Initial proposal 2-1-8:***

For inter-site gNB-gNB adjacent-channel CLI modeling, reuse similar method as inter-site gNB-gNB co-channel inter-subband CLI modeling with gNB ACLR for TX leakage and gNB ACS for Receiver impairment

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | Fine with this proposal. |
| Huawei, HiSilicon | Support. |
| Sony | Support. |
| MediaTek | Fine with the proposal |
| Ericsson | We support this proposal. |
| New H3C | Support |
| QC | Support in principle. However, this can be further discussed after we settle on modeling the inter-site co-channel interference. |

#### ***Initial proposal 2-1-9:***

For UE-UE adjacent-channel CLI modelling, reuse similar method as inter-site gNB-gNB co-channel inter-subband CLI modeling with UE ACLR for TX and UE ACS for RX.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | Fine with this proposal. |
| Huawei, HiSilicon | Support. |
| Sony | Support. |
| MediaTek | Fine with the proposal. |
| Ericsson | We support this proposal. |
| New H3C | Support |
| QC | Support in principle. This can be further discussed after we settle on modeling the inter-site co-channel interference. |

## Issue#2-2: Performance metrics

### Submitted proposal

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| CMCC | ***Proposal 10:*** Both Type-1 RU and Type-2 RU defined for SBFD are reused for dynamic TDD evaluation.  ***Proposal 11:*** RAN1 to conduct a SLS calibration for evaluation of SBFD operation.   * The calibration focuses on a subset of scenarios of SBFD deployment case 1   + FR1: Indoor office, Urban Macro   + FR2: Indoor office, Dense Urban Macro layer * The metrics used for SLS calibration includes:   + CDF of DL SINR in DL-only slots   + CDF of DL SINR in SBFD slots   + CDF of UL SINR in UL-only slots   + CDF of UL SINR in SBFD slots |
| Huawei | ***Proposal 23:*** *Adopt the Type-2 RU (Follow TR 36.814) agreed for SBFD in RAN1#100 for dynamic TDD evolution.*   * *DL/UL Type-2 RU = Number of RBs per cell used by traffic for the given link direction during observation time / Total number of RBs per cell available for traffic for the given link direction over observation time.* * *Note: In case of MU-MIMO, one RB allocated to N users within a cell is only counted as used once.*   ***Proposal 24:****The blocking interference of gNB suffered by other gNBs should be evaluated in system level simulation with the definition provided as follows:*  *where,*   * *is the blocking of gNB suffered by all other gNB on each Rx chain.* * *is the blocking from gNB to gNB on each Rx chain.*   + *is the total DL transmit power across all Tx chains at gNB .*   + *is the channel between gNB to gNB at DL frequency unit .*   + *is the precoder at gNB at DL frequency unit , except for*  *in the case of that the DL frequency unit is not scheduled.*   + *is the number of Rx chains for gNB .* |
| ZTE | ***Proposal 5****: RAN1 firstly calibrates geometry based on the following simplified interference model defined by RAN1 and secondly calibrates geometry based on RAN4’s input once it is available.*   |  |  |  |  | | --- | --- | --- | --- | | Interference | | | Simplified interference models for calibration | | Self-interference | | | Self-interference is suppressed to (Noise floor – 6dB)  Frequency flat over all the UL subband | | gNB-gNB co-channel inter-subband | Co-site inter-sector | | The same assumption as self-interference | | Inter-site | | TX leakage: gNB ACLR  Receiver impairment: gNB ACS  Tx and Rx isolation: path loss between the aggressor gNB and victim gNB | | UE-UE co-channel inter-subband | | | TX leakage: UE ACLR  Receiver impairment: UE ACS  Tx and Rx isolation: path loss between the aggressor UE and victim UE | | gNB-gNB adjacent channel interference | | Co-site inter-sector | The same assumption as self-interference | | Inter-site | TX leakage: gNB ACLR  Receiver impairment: gNB ACS  Tx and Rx isolation: path loss between the aggressor gNB and victim gNB | | UE-UE adjacent channel interference | | | TX leakage: UE ACLR  Receiver impairment: UE ACS  Tx and Rx isolation: path loss between the aggressor UE and victim UE |   ***Proposal 14****: Apply Type-2 RU definition for dynamic TDD simulation.* |
| Ericsson | Proposal 17: RAN1 to agree that companies report Type-1 RU in the agreement as mean resource utilization for dynamic/flexible TDD evaluations. |
| Samsung | *Proposal 5: For dynamic TDD operation, the Type-2 RU definitions are revised to*   * *Type-2 RU: DL/UL Type-2 RU =* *Number of RBs per cell used by traffic for the given link direction during observation time / Total number of RBs per cell available for traffic for the given link direction and the undetermined direction (i.e., flexible symbols) over observation time* |
| Qualcomm | **Proposal 10: For subband full duplex evaluation scenario, support SBFD slot utilization is additional metric.** |
| DOCOMO | **Proposal 4: DL Geometry and Coupling gain are baseline for calibration metrics, and UL SINR is considered for additional calibration metrics for Deployment Case 1.** |
| CATT | **Proposal 3: Adopt Type-1’ RU and/or Type-2 RU for dynamic TDD evaluations**   * **Type-1’ RU: DL/UL Type-1 RU = Number of RBs per cell used by traffic for the given link direction during observation time / Total number of all the RBs per cell including DL and UL over observation time.** * **Type-2 RU (Follow TR 36.814): DL/UL Type-2 RU = Number of RBs per cell used by traffic for the given link direction during observation time / Total number of RBs per cell available for traffic for the given link direction over observation time.** |
| Xiaomi | **Proposal 5: The definition provided in Table 1 is adopted for SBFD and dynamic/flexible TDD evaluation.**   |  |  |  | | --- | --- | --- | | Output metric | Definition | Source | | DL/UL received SINR | Received SINR = Effective signal power / (Interference+Noise) |  | | Coverage | The budget template defined for coverage enhancement can be used as a starting point. Self-interference and CLI should be reflected. | TR38.830 | |
| Spreadtrum | ***Proposal 10: In dynamic/flexible TDD, calibration for Hetnet scenario is needed.***  ***Proposal 11: Type-2 RU definition can be used for dynamic TDD evaluations.***  ***Proposal 12: Calibration on SBFD and dynamic/flexible TDD should be performed.***  ***Proposal 14: Energy consumption should be taken into account in duplex evolution or in R18 network energy saving.*** |
| Intel | **Proposal 11:**   * **RAN1 to conduct an SLS calibration for evaluation of SBFD operation.** * **The calibration focuses on a subset of scenarios of SBFD deployment case 1:**   + **FR1: Indoor office**   + **FR2: Indoor office** * **The metrics used for SLS calibration includes:**   + **CDF of DL SINR in DL-only slots**   + **CDF of DL SINR in SBFD slots**   + **CDF of UL SINR in UL-only slots**   + **CDF of UL SINR in SBFD slots** * **For calibration only purposes, frequency flat ACLR-like model is used to model self-interference where specific RSIC values are down-selected from the range of values provided by RAN4.** |

### Summary

**Remaining issue on resource utilization**

In RAN1#110 meeting, agreement was achieved on resource utilization with FFS on RU definition for dynamic TDD evaluations.

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| **Agreement**  Two types of RU (Resource utilization) are defined for SBFD evaluation.   * Type-1 RU: DL/UL Type-1 RU = Number of RBs per cell used by traffic for the given link direction during observation time / Total number of all the RBs per cell including DL, UL and guard bands over observation time. * Type-2 RU (Follow TR 36.814): DL/UL Type-2 RU = Number of RBs per cell used by traffic for the given link direction during observation time / Total number of RBs per cell available for traffic for the given link direction over observation time * Note: In case of MU-MIMO, one RB allocated to N users within a cell is only counted as used once. * Companies are to submit results for both RU definitions * FFS: RU definition for dynamic TDD evaluations |

Regarding the FFS, either or both of Type-1 RU and Type-2 RU are suggested by companies for dynamic TDD evolution.

* Type-1 RU only: suggested by one company [Ericsson]
* Type-2 RU only: suggested by four companies [Huawei, ZTE, Samsung, Spreadtrum]
* Both Type-1 RU and Type-2 RU only: suggested by one company [CMCC]
* Type-1 RU and/or Type-2 RU: suggested by one company [CATT]

For Type-2 RU, Samsung raises a question on whether the undetermined direction (i.e., flexible symbol) is counted for the denominator of Type-2 RU.



(a) Flexible symbol counted for the denominator (b) Flexible symbol not counted for the denominator

Moderator suggests **Initial proposal 2-2-1** based on the submitted proposals.

**SLS calibration**

Some companies [ZTE, DOCOMO, Spreadtrum, Intel] suggest RAN1 to conduct an SLS calibration for evaluation of SBFD operation. Moderator suggests **Initial question 2-2-2** to collect more views on this.

**Others**

Huawei thinks the blocking interference of gNB suffered by other gNBs should be evaluated in system level simulation.

Qualcomm suggests SBFD slot utilization as an additional metric.

### 1st Round Proposals

#### ***Initial proposal 2-2-1:***

For dynamic TDD evaluations, two types of RU defined for SBFD evaluation can be reused. Type-2 RU for dynamic TDD is further clarified as below.

* DL/UL Type-2 RU = Number of RBs per cell used by traffic for the given link direction during observation time / Total number of RBs per cell available for traffic for the given link direction over observation time
  + Note: the flexible symbols are counted as DL or UL based on semi-static or dynamic DL/UL indication. If a flexible symbol is not indicated as DL or UL, it is counted as DL by default.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | Our first preference is to adopt Type-2 RU, but we are also open to consider Type-1 RU considering that Type-1 RU is also applicable to dynamic TDD flexible symbols. |
| Huawei, HiSilicon | Support. |
| Sony | Not support.  If Flexible symbol is not indicated as DL or UL, why is it default to DL? This would increase the denominator for the DL RU. Isn’t it better to not consider the Flexible Symbols that are not indicated as either DL or UL? |
| Ericsson | For dynamic TDD FFFFF slot configuration, what is the total number of RBs per cell available for a given traffic for the given link direction over observation time? We do not see a need to complicate the RU for dynamic TDD evaluations, one can use the type 1 RU. |
| QC | Type-1 RU could be baseline as there is no ambiguity on how to compute the total number of resources per-traffic as for Type-2 RU.  Added note is not clear and reasonable to us. |

#### ***Initial question 2-2-2:***

Whether RAN1 to conduct a SLS calibration for evaluation of SBFD operation? If the answer is YES, which scenarios should be chosen for calibration for FR1 and FR2-1? What metrics and detailed definitions should be used for SLS calibration?

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| ZTE | Yes, calibration is necessary from our perspective.  Most of the major full-release study items have conducted simulation calibration to ensure an aligned baseline among companies. Without calibration, it may be difficult (or cause much trouble) in the end of this SI to make conclusions based on companies’ simulation results.  From our perspective, we can use the following scenarios and metrics for SLS calibration:   * Deployment case 1: Urban macro, Indoor office * Performance metrics: Geometry DL-SINR and geometry UL-SINR for both legacy TDD and SBFD   For DL, we can assume full buffer; for UL, we can assume a simple scheduling mechanism to simulate the interference, e.g., every UE utilizes the same number of UL RBs, i.e., number of total RBs in the subband/number of UEs. |
| Huawei, HiSilicon | Yes, SLS calibration is needed.  Deployment Case 1 with Urban Macro scenario and Indoor hotspots scenario can be chosen for calibration for FR1. And Dense Urban Macro layer scenario and Indoor hotspots scenario can be chosen for calibration for FR2-1.  Performance metric: Consider DL geometry and coupling loss at least, we are also open to other metrics if the impact from scheduler implementation can be avoided. |
| Sony | I would have thought the whole point of this simulation exercise is to calibrate the results among companies. We should at least calibrate the baseline scenarios. |
| MediaTek | Yes, we think calibration will be useful.  We suggest calibrating the inter-gNB CLI and inter-UE CLI. |
| Ericsson | We are neutral on this topic. We understand the desire to calibrate but we also think that it is highly challenging to calibrate simulators from different companies with so many parameters. |
| QC | Yes, case 1 (Urban Marco for FR1 and Dense Urban Macro Layer for FR2-1).  Metric: UL/DL SINR plots with and without co-channel inter-gNB and iner-UE CLI modelling. |

## Issue#2-3: Layout and UE distribution

### Submitted proposal

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| **Company** | **Proposals** |
| CMCC | ***Proposal 12:*** For Dense Urban with 2-layer, the minimum distance between macro TRP and micro TRP center (Dmacro-to-micro-center) is updated from [105m] to 42m.  ***Proposal 13:*** Confirm the working assumption made in RAN1#110 meeting on layout related simulation assumptions with modification.   |  |  |  |  | | --- | --- | --- | --- | | **Parameters** | **Indoor office** | **Urban macro / Dense Urban Macro layer** | **Dense Urban with 2-layer** | | **Layout** | Single layer  Indoor floor: (12BSs per 120m x 50m) | Single layer Macro layer:   * Baseline: Hexagonal grid with 7 macro sites and 3 sectors per site with wrap around * Optional: Hexagonal grid with 19 macro sites and 3 sectors per site with wrap around. | Two layer  Macro layer:   * Baseline: Hexagonal grid with 7 macro sites and 3 sectors per site with wrap around * Optional: Hexagonal grid with 19 macro sites and 3 sectors per site with wrap around.   Micro layer: According to previous agreement   * Baseline: 3 Micro BSs per Macro BS * Optional: 6, or 9 Micro BSs per Macro BS | | **Inter-BS (2D) distance** | 20m [TR 38.802 Table A.2.1-11] | 500m for Urban Macro [TR 38.802 Table A.2.1-11]  200m for Dense Urban Macro layer [TR 38.802 Table A.2.1-1] | **Macro-to-macro:** 200m  **Minimum Macro-to-micro-center distance:** ~~105m~~ 42m  **Minimum Micro-center-to-micro-center distance:** 57.9m | | **Minimum BS-UE (2D) distance** | 0m [TR 38.802 Table A.2.1-11] | 35m [TR 38.802 Table A.2.1-11] | **Macro-to-UE**: 35m  **Micro-to-UE**: 10m  [TR 38.802 Table A.2.1-11] | | **Minimum UE-UE (2D) distance** | ~~FFS~~ 1~3m [TR 38.828 Table 5.2.1.1.2-1] | ~~FFS~~ :3m [TR 38.802 Table A.2.1-11] | ~~FFS:~~ 3m [TR 38.802 Table A.2.1-11] | | **BS antenna height** | 3 m [TR 38.802 Table A.2.1-1] | 25 m [TR 38.802 Table A.2.1-1] | 25m for macro cells and 10m for micro cells [TR 38.802 Table A.2.1-1] |   ***Proposal 14:*** Update the previous agreement in RAN1#110 as below:  For UE distribution of Urban Macro and Dense Urban Macro layer,   * Baseline: (UE clustering at least for FR1)   + *M* users per macro TRP (per direction)     - Step 1: Randomly drop *X* UE cluster centers within one macro cell geographical area considering the minimum distance between macro TRP to UE cluster center as Dmacro-to-cluster and the minimum distance between two UE cluster centers as Dinter-cluster     - Step 2: *Y%* UEs are randomly and uniformly dropped within the UE clusters with the radius of R, (1-*Y%*) users randomly and uniformly dropped in the macro geographical area outside the clusters     - Note: UEs dropped within the UE cluster(s) are indoor with 3km/h; UEs dropped outside the UE cluster(s) are outdoor in car with 30km/h     - UE outdoor/indoor proportion: 20% outdoor in cars: 30km/h; 80% indoor in houses: 3km/h       * Outdoor UEs: 1.5 m;       * ~~FFS: Indoor UEs height~~       * Indoor UEs: 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8)     - Y%=80%, *M* = 10, X = 3     - ~~FFS the values of~~ *~~M~~*~~, X~~*~~,~~* ~~D~~~~macro-to-cluster~~~~, D~~~~inter-cluster~~*~~,~~* ~~R~~     - For Urban Macro for FR1: Dmacro-to-cluster = 105 m, Dinter-cluster = 144.8 m, R = 72.3 m     - For Dense Urban Macro layer for FR1 and FR2-1: Dmacro-to-cluster = 42m, Dinter-cluster = 57.9 m, R = 28.9 m * Optional:   + 10 users per macro TRP (per direction), and all users are randomly and uniformly dropped within the macro cell   + ~~At least f~~For FR1: 20% outdoor in cars: 30km/h; 80% indoor in houses: 3km/h     - Outdoor UEs: 1.5 m;     - Indoor UEs: 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8) [refer to TR 36.873 Table 6-1]     - ~~FFS: FR2 details~~   + For FR2-1:     - Baseline: 100% Outdoor in cars: 30km/h     - Optional: 20% Outdoor in cars: 30km/h, 80% Indoor in houses: 3km/h       * Outdoor UEs: 1.5 m;       * Indoor UEs: 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8)   ***Proposal 15:*** For 2-layer Scenario B (HetNet with Urban Macro and Indoor),   * Layer 1: Urban Macro   + Baseline: Hexagonal grid with 7 macro sites and 3 sectors per site with wrap around, ISD=500m   + Optional: Hexagonal grid with 19 macro sites and 3 sectors per site with wrap around, ISD=500m * Layer 2:   + One building randomly dropped per macro cell with random orientation.   + Assume Indoor office or Indoor factory for each building (companies to report which one is used)     - Indoor office: [3] BSs per 120m x 50m     - Indoor factory: companies to report the detailed evaluation parameters for InF.   + The minimum distance between Macro to Indoor TRxP: [35 m] [TR 38.828 Table 5.2.1.1.2-1] * UE distribution: M users per macro geographical area (per direction), Y% UEs are randomly and uniformly dropped within the building, and (1-Y%) UEs are randomly and uniformly dropped in the macro geographical area outside the buildings.   + Note: UEs dropped within the building are indoor with 3km/h; UEs dropped outside the building are outdoor in car with 30km/h   + UEs height for both indoor and outdoor: 1.5m   + Y%=[80%], M=[30] |
| Huawei | ***Proposal 1:*** *Confirm the Working Assumption in RAN1#110 about the parameters of Deployment Case 1/2 with minimum UE-UE (2D) distance 3m.*  ***Proposal 2:*** *The following parameters for UE clustering should be supported at least:*   * *UE number per macro cell: ;* * *Cluster number per macro cell: ;* * *UE height for indoor UEs: 1.5m;* * *Radius of cluster:*   + *UMa scenario: ;*   + *Dense Urban Macro layer scenario: ;* * *Minimum distance between macro TRP to UE cluster center:*   + *UMa scenario: ;*   + *Dense Urban Macro layer scenario: ;* * *Minimum distance between two UE cluster centers:*   + *UMa scenario: ;*   + *Dense Urban Macro layer scenario: .*   ***Proposal 4:*** *For Deployment Case 3-2 (HetNet scenario), adopt the following 2-step method for the cell layout generation:*   * *Step 1: Drop an Urban Macro layer with hexagonal grid with 7 macro sites and 3 sectors per site;* * *Step 2: Randomly drop an indoor factory/office layer with 12 BSs per (m) throughout the macro geographical area considering the minimum distance between macro TRP to indoor office center, e.g., 100m.*   ***Proposal 5:*** *For Deployment Case 3-2 (HetNet scenario), adopt the following method for UE distribution:*   * *Urban Macro layer:*   + *10 users per macro TRP, and all users are randomly and uniformly dropped within the macro cell;*   + *20% outdoor in cars: speed with 30km/h, height with 1.5m;*   + *80% indoor in houses: speed with 3km/h, height with 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8);* * *Indoor office layer:*   + *10 users per pico TRP, and all users are randomly and uniformly dropped within the pico cell;*   + *100% indoor in houses: speed with 3km/h, height with 1.5m.*   ***Proposal 7:*** *For HetNet with Urban Macro and indoor office/indoor factory deployed in the same carrier in FR1, more details for evaluation should be determined.*   * *FFS UE distribution and serving cell selection.* |
| ZTE | ***Proposal 6****: Update the previous agreements reached in RAN1#110 as following.*  **Agreement**  For Dense Urban with 2-layer for FR1, consider micro cell TRPs are deployed as following   * Step 1: Randomly drop **3** micro TRP centers within one macro cell geographical area considering the minimum distance between micro TRP centers (Dinter-micro-center) and the minimum distance between macro TRP and micro TRP center (Dmacro-to-micro-center). * Step 2: Randomly deploy one micro TRP on the area circle around each micro TRP center with the radius of half of Dinter-micro-center * Step 3: Determine the horizontal angle of the micro TRPs with the planer facing to the micro TRP center. * Dinter-micro-center = **40 m**, Dmacro-to-micro-center = **30 m**   ***Proposal 7****: For UE distribution of Urban Macro and Dense Urban Macro layer,*   * *1 or 2 UE clusters per macro TRP.* * *Radius of UE cluster, R=20m* * *Regarding minimum distance between macro TRP to UE cluster centre*   + *For Urban Macro, Dmacro-to-cluster = 35+20=55m*   + *For Dense urban macro, Dmacro-to-cluster = 10+20=30m* * *Minimum distance between two UE cluster centres, Dinter-cluster = 57.9m* * *Antenna height for indoor UEs, 1.5m* * *minimum UE-UE distance, 1~3m up to companies to report* |
| Ericsson | Proposal 16: RAN1 to agree the following parameters in FFS for the agreed baseline UE clustering   * 1. Indoor UEs height is at 1.5m inside the clusters   2. M = 10 users per macro TRP   3. X = 1 indoor cluster per macro TRP   4. Dinter-cluster is not needed when X=1   5. Companies can report Dmacro-to-cluster and R. |
| Samsung | *Proposal 1: For UE clustering model, RAN1 to agree the following parameters*   * *M (# of UEs per macro TRP) = 10* * *X (# of clusters) = 2* * *R (radius of a cluster) = 25 m* * *Dmacro-to-cluster: 60m (same as Minimum BS-UE (2D) distance+R)* * *Dinter-cluster: 50 m (same as 2\*R)* * *Indoor UEs height: for each UE, the height is*    + *3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8) [refer to TR 36.873 Table 6-1] (same as in Optional)*   *Proposal 2: For deployment case 4, RAN1 to down-select one option from the following two options*   * *Option 1. Cluster centers for each operator are independently dropped.* * *Option 2. Cluster centers for operator A are dropped. The cluster centers are used for operator B.*   + *FFS: grid shift case*   *Proposal 3: RAN1 to agree the following minimum UE-UE distance*   * *Indoor hotspot: 1m as baseline, 0.1m as optional* * *Urban macro/Dense Urban Macro layer: 3m as baseline, 1m as optional* |
| Qualcomm | **Observation 6: At 4GHz, floor-to-floor loss for UEs in adjacent floors is 24 dB which is pretty high. UEs in different floor will have high isolation which will defeat the purpose of UE clustering.**  **Proposal 3: To reduce simulation time and overhead, UE clustering is performed by dropping a single cluster (X =1) single floor within each macro cell geographical area where number of UEs per macro TRP is 10 (M=10)**   * **The cluster size R = 25 m** * **The minimum distance between cluster centre and gNB (Dmacro-to-cluster = 100 m)** * **All indoor UEs are assumed on the first floor.** * **When UE assigned fixed traffic direction, half of the UE are assigned DL and other half are assigned UL.**   **Proposal 4: Support 100% outdoor UE locations** **to evaluate outdoor scenarios for FR2 as baseline.**  **Proposal 5: confirm the working assumption on deployment layout with following changes..**   * **For Dense-Urban with 2-layers, support 1 Micro BS per Macro BS to reduce simulation overhead.** * **A uniform minimum UE-UE distance is 1.5 m for all deployment scenarios.**   **Proposal 6: For InH, support ceiling mounted TRP deployment with Boresight direction is perpendicular to the ceiling and layout parameters in Table 1.**  **Proposal 7: For UMa, support hexagonal grid cell layout with 7 macro sites, 3 sector per side (ISD = 500) related configuration in Table 2.**  **Proposal 8: For HetNet, support UMa hexagonal grid of 7 macro sites and three sectors per site (ISD = 500m).**   * **one InH layout is dropped randomly for each macro sector. FFS: #TRPs per InH.** * **The Indoor office is assumed single floor of size 120m x 50m x 3m with 3-site deployment.** * **FFS: serving cell determination for Indoor and outdoor UE.** |
| Nokia | ***Observation 2: Unacceptable DL throughput performance (>90% degradation with full buffer traffic) is observed with SBFD when 80% of the UEs in each cell are placed in a cluster of 35 meter radius. With a cluster radius of 70 meter, performance degradation of 20% is observed.***  **Proposal 5: For the UE clustering model adopted for Urban Macro and Dense Urban Macro, adopt the following additional parametrization as baseline:**   * **One cluster per cell (*M*=1). For the cluster dimensions, re-use the assumptions in TR 36.872 (LTE Small cell study) which are: R = 70m, Dmacro-to-cluster = 105m, Dinter-cluster= 2\*R.** * **For the number of UEs per Macro TRP, consider i) 10 or 20 UEs per cell for the case where each UE generate both UL and DL traffic (Option 2 as per RAN1#110 agreement) and ii) 20 or 40 UEs per cell for the case where each UE generate either UL or DL traffic (Option 1).** * **For the UE height, consider 1.5 m for all UEs within the cluster.** |
| MediaTek | ***Observation 1: Uniform random distribution does not depict a real-world scenario whereby users congregate to form groups/clusters.***  ***Proposal 3: For the evaluations of SBFD and DTDD schemes, RAN1 should consider the following clustering method to accurately capture the impact of inter-UE CLI:***   * ***UEs in the same cluster deployed on the same floor, and the floor for the cluster is selected randomly. Multiple clusters can be deployed in a building.*** |
| LG | ***Proposal 1:*** In case of UE clustering for UE distribution of Urban Macro and Dense Urban Macro layer, following indoor UE height is adopted;  3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8) |
| CATT | **Proposal 5: Adopt the following parameters for UE clustering.**   * **Indoor UEs height:1.5m** * **M=10 , X=3** * **For Urban Macro for FR1:**    + **Dmacro-to-cluster = 262.5 m (=500 / 200 \* 105m) , Dinter-cluster = 144.8 m (=500 / 200 \* 57.9), R = 72.3 m (= 500 / 200 \* 28.9m)** * **For Dense Urban Macro layer for FR2-1:**    + **Dmacro-to-cluster = 105 m, Dinter-cluster = 57.9 m, R = 28.9 m**   **Proposal 6: Confirm the work assumptions on deployment and adopt the following value for minimum UE-UE distance.**   * **Indoor office: 1~3m [TR 38.828 Table 5.2.1.1.2-1]** * **Urban macro / Dense Urban Macro layer: 3m [TR 38.802 Table A.2.1-11]** |
| Xiaomi | **Proposal 2: Confirm the following working assumption with a unified minimum UE-UE(2D) distance across different scnarios: 3m**  **Proposal 3: For UE distribution of Urban Macro and Dense Urban Macro layer, the following parameter values can be applied to cluster based UE distribution at least for FR1:**   * **Dmacro-to-cluster=35+28.9m** * **Dinter-cluster = 57.9 m** * **R = 28.9m** * **Indoor UE height = 1.5m** |
| Spreadtrum | ***Proposal 2: For Dense Urban with 2-layer for FR1, the minimum distance between macro TRP and micro TRP center (Dmacro-to-micro-center) should be 42m instead of 105m.***  ***Proposal 3: For UE distribution of Urban Macro and Dense Urban Macro layer,***   * ***Baseline: (UE clustering at least for FR1)***   + ***M users per direction per macro TRP***     - ***Step 1: Randomly drop X UE cluster centers within one macro cell geographical area considering the minimum distance between macro TRP to UE cluster center as Dmacro-to-cluster and the minimum distance between two UE cluster centers as Dinter-cluster***     - ***Step 2: Y% UEs are randomly and uniformly dropped within the UE clusters with the radius of R, (1-Y%) users randomly and uniformly dropped in the macro geographical area outside the clusters***     - ***Note: UEs dropped within the UE cluster(s) are indoor with 3km/h; UEs dropped outside the UE cluster(s) are outdoor in car with 30km/h***     - ***UE outdoor/indoor proportion: 20% outdoor in cars: 30km/h; 80% indoor in houses: 3km/h***       * ***Outdoor UEs: 1.5 m;***       * ***FFS: Indoor UEs height***     - ***Y%=80%***     - ***M=60, X =3, Dmacro-to-cluster =105m, Dinter-cluster= 114.8m, R =72.3m*** * ***Optional:***    + ***10 users per macro TRP (per direction), and all users are randomly and uniformly dropped within the macro cell***   + ***At least for FR1: 20% outdoor in cars: 30km/h; 80% indoor in houses: 3km/h***     - ***Outdoor UEs: 1.5 m;***     - ***Indoor UEs: 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8) [refer to TR 36.873 Table 6-1]***     - ***FFS: FR2 details***   ***Proposal 4: Minimum distance between UEs in different scenarios can be set to 3m as working assumption for duplex evaluation.***  ***Proposal 8: For HetNet with Urban Macro and Indoor office, consider the following topology***   * ***Macro layer: Hexagonal grid, 7 micro sites, 3 sectors per site, ISD=500m*** * ***Indoor layer:***    + ***One building randomly dropped and horizon placed per macro cell***   + ***Layout for each building: Indoor with single floor ([3] BSs per 120m x 50m)***   + ***The minimum distance between Macro to indoor office center: [100 m]*** * ***UE distribution: Y% UEs are randomly and uniformly dropped within the building, and (1-Y%) UEs are randomly and uniformly dropped outside the building and throughout the macro geographical area, and N users per macro geographical area.***   + ***Note: UEs dropped within the building are indoor with 3km/h; UEs dropped outside the building are outdoor in car with 30km/h***   + ***Y%=[80%], N=[10] per direction***   ***Proposal 9: For HetNet with Urban Macro and Indoor, indoor/outdoor UE can only select indoor/macro cell as serving cell.*** |
| New H3C | **Proposal 1: For UE distribution of Urban Macro and Dense Urban Macro layer, the set of values ] can be used for FFS parameters value of the baseline as follows:**  **X=[3], Y%=[2/3];**  **For Urban Macro for FR1: Dmacro-to-cluster = [262.5 m], Dinter-cluster = [114.8 m], R = [72.3 m];**  **For Dense Urban Macro layer for FR1 and FR2-1: Dmacro-to-cluster = [105 m], Dinter-cluster = [57.9 m], R = [28.9 m.**  **Proposal 2: For minimum BS-UE (2D) distance for SBFD and dynamic/flexible TDD evaluation, minimum BS-UE (2D) distance value (3m) defined in TR 38.802 for flexible duplex should be reused.** |
| Intel | **Proposal 3:**   * **For indoor office deployments, no minimum distance across UEs is considered, while for other deployments 3m is assumed.**   **Proposal 6:**   * **For the UE clustering model, the following parameters are adopted:** * **M is set to 10 users** * **X is set to 3**   + **For Urban Macro for FR1: Dmacro-to-cluster = [262.5 m], Dinter-cluster = [114.8 m], R = [72.3 m]**   + **For Dense Urban Macro layer for FR1 and FR2-1: Dmacro-to-cluster = [105 m], Dinter-cluster = [57.9 m], R = [28.9 m]**   **Proposal 7:**   * **For indoor deployments, the height of the UEs is set to 1 m** |
| KT (R1-2208531) | ***Proposal 2: Minimum UE-UE (2D) distance to be set to 3m*** |

### Summary

**Dense Urban with 2-layer for FR1**

In RAN1#110, agreement was achieved for Dense Urban with 2-layer for FR1.

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| **Agreement**  For Dense Urban with 2-layer for FR1, consider micro cell TRPs are deployed as following   * Step 1: Randomly drop [3] micro TRP centers within one macro cell geographical area considering the minimum distance between micro TRP centers (Dinter-micro-center) and the minimum distance between macro TRP and micro TRP center (Dmacro-to-micro-center). * Step 2: Randomly deploy one micro TRP on the area circle around each micro TRP center with the radius of half of Dinter-micro-center * Step 3: Determine the horizontal angle of the micro TRPs with the planer facing to the micro TRP center. * Dinter-micro-center =[57.9 m], Dmacro-to-micro-center = [105 m] |

Three companies [Spreadtrum, ZTE, CMCC] observe that the minimum distance between Macro TRP and Micro TRP center (Dmacro-to-micro-center = [105 m]) is not proper. Although the number is set according to TR38.802, assuming ISD of 200m of Macro cells, 3 Micro TRPs can only be dropped in the green area in Figure below. But the maximum distance of the green area is much less than the minimum distances of two Micro TRP which makes it impossible to randomly drop 3 Micro TRPs in one Macro cell. Tracking back to the reference parameters in Table A.2.2-11 of TR38.802, inter-BS distance of Macro-to-micro is defined according to TR36.897. But in TR36.897, the ISD of Macro cell is 500m, so two companies [Spreadtrum, CMCC] suggest the distance should be scaled to Dmacro-to-micro-center = [42m] (=200/500\*105m). ZTE suggests Dinter-micro-center = 40 m and Dmacro-to-micro-center = 30 m. In addition, Qualcomm suggests to support 1 Micro BS per Macro BS to reduce simulation overhead.



Moderator suggests **Initial proposal 2-3-1** based on the submitted proposals.

**Layout related Working Assumption**

In RAN1#110, working assumption was made about the layout related simulation assumptions with FFS on Minimum UE-UE (2D) distance.

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| **Working Assumption**   |  |  |  |  | | --- | --- | --- | --- | | **Parameters** | **Indoor office** | **Urban macro / Dense Urban Macro layer** | **Dense Urban with 2-layer** | | **Layout** | Single layer  Indoor floor: (12BSs per 120m x 50m) | Single layer Macro layer:   * Baseline: Hexagonal grid with 7 macro sites and 3 sectors per site with wrap around * Optional: Hexagonal grid with 19 macro sites and 3 sectors per site with wrap around. | Two layer  Macro layer:   * Baseline: Hexagonal grid with 7 macro sites and 3 sectors per site with wrap around * Optional: Hexagonal grid with 19 macro sites and 3 sectors per site with wrap around.   Micro layer: According to previous agreement   * Baseline: 3 Micro BSs per Macro BS * Optional: 6, or 9 Micro BSs per Macro BS | | **Inter-BS (2D) distance** | 20m [TR 38.802 Table A.2.1-11] | 500m for Urban Macro [TR 38.802 Table A.2.1-11]  200m for Dense Urban Macro layer [TR 38.802 Table A.2.1-1] | **Macro-to-macro:** 200m  **Minimum Macro-to-micro-center distance:** 105m  **Minimum Micro-center-to-micro-center distance:** 57.9m | | **Minimum BS-UE (2D) distance** | 0m [TR 38.802 Table A.2.1-11] | 35m [TR 38.802 Table A.2.1-11] | **Macro-to-UE**: 35m  **Micro-to-UE**: 10m  [TR 38.802 Table A.2.1-11] | | **Minimum UE-UE (2D) distance** | FFS | FFS :3m [TR 38.802 Table A.2.1-11] | FFS: 3m [TR 38.802 Table A.2.1-11] | | **BS antenna height** | 3 m [TR 38.802 Table A.2.1-1] | 25 m [TR 38.802 Table A.2.1-1] | 25m for macro cells and 10m for micro cells [TR 38.802 Table A.2.1-1] | |

Regarding the Minimum UE-UE (2D) distance,

* For deployment scenarios other than Indoor office,
  + Eight companies [Huawei, Xiaomi, Spreadtrum, New H3C, KT, CATT, Intel, CMCC] suggest 3m.
  + Samsung suggests 3m as baseline, 1m as optional.
  + ZTE suggests 1~3m up to companies to report
  + Qualcomm suggests 1.5m
* For Indoor office,
  + Five companies [Huawei, Xiaomi, Spreadtrum, New H3C, KT] suggest for 3m.
  + Two companies [CATT, CMCC] suggest 1~3m up to companies to report.
  + Qualcomm suggests 1.5m
  + Intel suggests 0m
  + Samsung suggests 1m as baseline, 0.1m as optional

Moderator suggests **Initial proposal 2-3-2** based on the submitted proposals.

**UE distribution of Urban Macro and Dense Urban Macro layer**

In RAN1#110, agreement was achieved on UE distribution of Urban Macro and Dense Urban Macro layer with some FFS.

|  |
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| **Agreement**  Update the previous agreement as below:  For UE distribution of Urban Macro and Dense Urban Macro layer,   * Baseline: (UE clustering at least for FR1)   + *M* users per macro TRP     - Step 1: Randomly drop *X* UE cluster centers within one macro cell geographical area considering the minimum distance between macro TRP to UE cluster center as Dmacro-to-cluster and the minimum distance between two UE cluster centers as Dinter-cluster     - Step 2: *Y%* UEs are randomly and uniformly dropped within the UE clusters with the radius of R, (1-*Y%*) users randomly and uniformly dropped in the macro geographical area outside the clusters     - Note: UEs dropped within the UE cluster(s) are indoor with 3km/h; UEs dropped outside the UE cluster(s) are outdoor in car with 30km/h     - UE outdoor/indoor proportion: 20% outdoor in cars: 30km/h; 80% indoor in houses: 3km/h       * Outdoor UEs: 1.5 m;       * FFS: Indoor UEs height     - Y%=80%     - FFS the values of *M*, X*,* Dmacro-to-cluster, Dinter-cluster*,* R * Optional:   + 10 users per macro TRP (per direction), and all users are randomly and uniformly dropped within the macro cell   + At least for FR1: 20% outdoor in cars: 30km/h; 80% indoor in houses: 3km/h     - Outdoor UEs: 1.5 m;     - Indoor UEs: 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8) [refer to TR 36.873 Table 6-1]     - FFS: FR2 details |

For the UE clustering at least for FR1,

* Regarding the parameter M (UE number per macro cell)
  + Eight companies [Huawei, Ericsson, Samsung, Qualcomm, CATT, Intel, CMCC] suggest M = 10
    - CMCC suggests M users per macro TRP (per direction), i.e., if each UE is either assigned UL traffic or DL traffic, there are 2M users per macro TRP, wherein, M UEs are assigned with UL traffic, and the other M UEs are assigned with DL traffic. If each UE is assigned both UL traffic and DL traffic, there are M users per macro TRP.
  + Nokia suggests to consider i) 10 or 20 UEs per cell for the case where each UE generate both UL and DL traffic (Option 2 as per RAN1#110 agreement) and ii) 20 or 40 UEs per cell for the case where each UE generate either UL or DL traffic (Option 1)
  + Spreadtrum suggests M=60
  + Moderator suggests **Initial proposal 2-3-3** for the value of M
* Regarding the parameter X (Cluster number per macro cell)
  + Five companies [CATT, Spreadtrum, New H3C, Intel, CMCC] suggest X = 3
  + Four companies [Huawei, Ericsson, Qualcomm, Nokia] suggest X = 1
  + ZTE suggests X = 1 or 2
  + Samsung suggests X = 2
* Regarding Indoor UEs height
  + Seven companies [Huawei, ZTE, Ericsson, Qualcomm, Nokia, CATT, Xiaomi] suggest 1.5m
  + Three companies [Samsung, LG, CMCC] suggest 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8)
  + MediaTek suggests that UEs in the same cluster deployed on the same floor, and the floor for the cluster is selected randomly. Multiple clusters can be deployed in a building.
  + Moderator thinks the value of X and Indoor UEs height can be determined together since there could be a tradeoff between the two values. There are two extreme cases: 1) X=1, Indoor UEs height = 1.5m; 2) *X*=3, Indoor UEs height = 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8). So, for compromise, moderator suggests **Initial proposal 2-3-4** as a middle ground.
* Regarding the parameters Dmacro-to-cluster (Minimum distance between macro TRP to UE cluster center), Dinter-cluster (Minimum distance between two UE cluster centers)*,* R (Radius of cluster)
  + Five companies [Samsung, Qualcomm, Nokia, Xiaomi, Spreadtrum] suggest common values for Urban Macro (ISD = 500m) and Dense Urban Macro layer (ISD = 200m)
    - Samsung suggests Dmacro-to-cluster = 60m (35m + R), Dinter-cluster = 50 m (2R), R = 25 m
    - Xiaomi suggests Dmacro-to-cluster = 63.9m (35m + R), Dinter-cluster = 57.9 m (2R), R = 28.9 m
    - Spreadtrum suggests Dmacro-to-cluster = 105 m, Dinter-cluster = 144.8 m, R = 72.3 m (Moderator thinks this is only suitable for ISD=500m)
    - Nokia suggests Dmacro-to-cluster = 105 m, Dinter-cluster = 140 m (2R), R = 70 m (Moderator thinks this is only suitable for ISD=500m)
    - Qualcomm suggests Dmacro-to-cluster = 100m, R = 25 m
  + Six companies [Huawei, ZTE, CATT, New H3C, Intel, CMCC] suggest different values for Urban Macro (ISD = 500m) and Dense Urban Macro layer (ISD = 200m)
    - For Urban Macro
      * Four companies [Huawei, CATT, New H3C, Intel] suggest Dmacro-to-cluster = 262.5 m(=500 / 200 \* 105m), Dinter-cluster = 144.8 m (=500 / 200 \* 57.9m), R = 72.25 m (= 500 / 200 \* 28.9m)
        + Note: as explained, there was a historical mistake to assign Dmacro-to-cluster =105m for Dense Urban Macro layer with 200m ISD. So, moderator thinks it should be Dmacro-to-cluster = 105 m for these four companies.
      * CMCC suggests Dmacro-to-cluster = 105 m, Dinter-cluster = 144.8 m (2R), R = 72.3 m
      * ZTE suggest for Dmacro-to-cluster = 55m (35m + R), Dinter-cluster = 57.9 m, R = 20 m
    - For Dense Urban Macro layer
      * Four companies [Huawei, CATT, New H3C, Intel] suggest Dmacro-to-cluster = 105 m, Dinter-cluster = 57.9 m (2R), R = 28.9 m
      * CMCC suggests Dmacro-to-cluster = 42m, Dinter-cluster = 57.9 m (2R), R = 28.9 m
      * ZTE suggests Dmacro-to-cluster = 30m (10m + R), Dinter-cluster = 57.9 m, R = 20 m
  + For simplicity and compromise, moderator suggests **Initial proposal 2-3-5**.

For FR2 details,

* Two companies [Qualcomm, CMCC] suggest 100% Outdoor in cars with 30km/h as baseline.
* CMCC suggest for 20% Outdoor in cars with 30km/h and 80% Indoor in houses with 3km/h as optional.
* Moderator suggests **Initial proposal 2-3-6**.

**2-layer Scenario B (HetNet with Urban Macro and Indoor)**

As proposed in **Initial proposal 1-1-1**, for 2-layer Scenario B

* Layer 1: Urban Macro
* Layer 2: Indoor office or Indoor factory (companies to report which one is used)
  + Regarding the Indoor office layer, reuse the Indoor office (InH) scenario and relevant channel model in TR38.901.
  + Regarding the Indoor factory layer, reuse the Indoor factory (InF) scenario and relevant channel model in TR38.901.

Regarding the Layer 1 (Urban Macro)

* Four companies [Huawei, Qualcomm, Spreadtrum, CMCC] suggest Hexagonal grid with 7 macro sites and 3 sectors per site with wrap around
* CMCC suggests to consider Hexagonal grid with 19 macro sites and 3 sectors per site with wrap around as optional.

Regarding the Layer 2 (Indoor office or Indoor factory)

* Four companies [Huawei, Qualcomm, Spreadtrum, CMCC] suggest one building randomly dropped per macro cell.
  + CMCC suggests for randomly dropped buildings with random orientation.
  + Spreadtrum suggests for buildings horizon placed
* For Indoor office for each building
  + Three companies [Qualcomm, Spreadtrum, CMCC] suggest 3 BSs per 120m x 50m
  + Huawei suggests for 12 BSs per 120m x 50m
* For Indoor factory for each building
  + CMCC suggests companies to report the detailed evaluation parameters for InF
* Two companies [Huawei, Spreadtrum] suggests the minimum distance between macro TRP to indoor office center as 100m
* CMCC suggests the minimum distance between Macro to Indoor TRxP as 35m [TR 38.828 Table 5.2.1.1.2-1]

Regarding the UE distribution,

* Two companies [Spreadtrum, CMCC] suggest M users per macro geographical area (per direction), Y% UEs are randomly and uniformly dropped within the building, and (1-Y%) UEs are randomly and uniformly dropped in the macro geographical area outside the buildings.
  + Note: UEs dropped within the building are indoor with 3km/h; UEs dropped outside the building are outdoor in car with 30km/h
  + UEs height for both indoor and outdoor: 1.5m
  + Y%=[80%],
  + CMCC suggests M = 30, while Spreadtrum suggests M = 10.
* Huawei suggests
  + Urban Macro layer:
    - 10 users per macro TRP, and all users are randomly and uniformly dropped within the macro cell;
    - 20% outdoor in cars: speed with 30km/h, height with 1.5m;
    - 80% indoor in houses: speed with 3km/h, height with 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8);
  + Indoor office layer:
    - 10 users per pico TRP, and all users are randomly and uniformly dropped within the pico cell;
    - 100% indoor in houses: speed with 3km/h, height with 1.5m.

Regarding the serving cell selection

* Huawei suggests for more discussion on serving cell selection.
  + Whether the UE in the indoor office/indoor factory can select the Macro cell as serving cell or not.
  + Whether the UE outside the indoor office/indoor factory can select the indoor small cell as serving cell or not.
* Spreadtrum suggests indoor/outdoor UE can only select indoor/macro cell as serving cell.

Moderator suggests **Initial proposal 2-3-7/2-3-8** as a compromise.

**Others**

For UE clustering under SBFD deployment case 4, Samsung suggests to down-select one option from the following two options

* Option 1. Cluster centers for each operator are independently dropped.
* Option 2. Cluster centers for operator A are dropped. The cluster centers are used for operator B.

### 1st Round Proposals

#### ***Initial proposal 2-3-1:***

Update the previous agreement made in RAN1#110 for Dense Urban with 2-layer with the following modifications.

* For Dense Urban with 2-layer for FR1, consider micro cell TRPs are deployed as following
  + Step 1: Randomly drop 1(baseline) or 3(optional) micro TRP centers within one macro cell geographical area considering the minimum distance between micro TRP centers (Dinter-micro-center) and the minimum distance between macro TRP and micro TRP center (Dmacro-to-micro-center).
  + Step 2: Randomly deploy one micro TRP on the area circle around each micro TRP center with the radius of half of Dinter-micro-center
  + Step 3: Determine the horizontal angle of the micro TRPs with the planer facing to the micro TRP center.
  + Dinter-micro-center =57.9 m, Dmacro-to-micro-center = 42m

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | Usually, we drop 3 micro TRPs within one macro cell geographical. We suggest to mark “3” as baseline and “1” as optional.  For Dmacro-to-micro-center = 42m, we can be ok use this value from our perspective if this is the majority view. However, we are not sure whether “Dinter-micro-center =57.9 m” is applicable or not. As shown below, the maximum length of one sector is 133.3m, it is even not possible to drop 3 micro TRPs in the same line. Thus, we propose Dinter-micro-center = 40, or Dinter-micro-center = Dmacro-to-micro-center = 42m. |
| Ericsson | We do not see a need to have more than 1 cluster per macro cell. If we assume 10 users per macro cell for Urban Macro and have similar number of UEs for Dense urban, it would be interesting to see the impact of CLI if 80% of those UEs are in a cluster indoors. The impact is reduced if they are split into 3 clusters. |
| QC | Support |

#### ***Initial proposal 2-3-2:***

Confirm the working assumption made in RAN1#110 on layout related simulation assumptions with modifications.

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | **Indoor office** | **Urban macro / Dense Urban Macro layer** | **Dense Urban with 2-layer** |
| **Layout** | Single layer  Indoor floor: (12BSs per 120m x 50m) | Single layer Macro layer:   * Baseline: Hexagonal grid with 7 macro sites and 3 sectors per site with wrap around * Optional: Hexagonal grid with 19 macro sites and 3 sectors per site with wrap around. | Two layer  Macro layer:   * Baseline: Hexagonal grid with 7 macro sites and 3 sectors per site with wrap around * Optional: Hexagonal grid with 19 macro sites and 3 sectors per site with wrap around.   Micro layer: According to previous agreement   * Baseline: 1 Micro BSs per Macro BS * Optional: 3 Micro BSs per Macro BS |
| **Inter-BS (2D) distance** | 20m [TR 38.802 Table A.2.1-11] | 500m for Urban Macro [TR 38.802 Table A.2.1-11]  200m for Dense Urban Macro layer [TR 38.802 Table A.2.1-1] | **Macro-to-macro:** 200m  **Minimum Macro-to-micro-center distance:** 42m  **Minimum Micro-center-to-micro-center distance:** 57.9m |
| **Minimum BS-UE (2D) distance** | 0m [TR 38.802 Table A.2.1-11] | 35m [TR 38.802 Table A.2.1-11] | **Macro-to-UE**: 35m  **Micro-to-UE**: 10m  [TR 38.802 Table A.2.1-11] |
| **Minimum UE-UE (2D) distance** | 1.5m | 3m [TR 38.802 Table A.2.1-11] | 3m [TR 38.802 Table A.2.1-11] |
| **BS antenna height** | 3 m [TR 38.802 Table A.2.1-1] | 25 m [TR 38.802 Table A.2.1-1] | 25m for macro cells and 10m for micro cells [TR 38.802 Table A.2.1-1] |

Companies are encouraged to provide comments in the table below.

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| --- | --- |
| **Company** | **Comment** |
| ZTE | Similar as above, in last meeting, companies have agreed to mark “3” micros per Macro as baseline, we prefer to keep it as is.  Regarding the minimum distance, our preference is 1~3m up to companies to report. We can also compromise to the current proposal. |
| Huawei, HiSilicon | Fine. |
| MediaTek | We don’t support the proposed “Minimum UE-UE (2D) distance”. We suggest more realistic values (~0.1 m). |
| Ericsson | We support the proposal in principle. |
| New H3C | Support |
| QC | Support in principle. However, on the minimum distance, we think a unified value of minimum UE 2D distance is preferred, e.g. 1.5 meter for all deployment scenario. |

#### ***Initial proposal 2-3-3:***

For UE clustering distribution of Urban Macro and Dense Urban Macro layer,

* *M*=10 users per macro TRP (per direction)
  + If each UE is either assigned UL traffic or DL traffic, there are 2*M* users per macro TRP, wherein, *M* UEs are assigned with UL traffic, and the other *M* UEs are assigned with DL traffic.
  + If each UE is assigned both UL traffic and DL traffic, there are *M* users per macro TRP.

Companies are encouraged to provide comments in the table below.

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| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | Fine. |
| Sony | Fine with the proposal. |
| MediaTek | We don’t support the proposal. It will not be possible to do the UE clustering with such small number of UEs, specially if we want to consider more than one cluster in each sector.  We suggest M=30. |
| Ericsson | We support the proposal in principle. |
| New H3C | Support |
| QC | We think that M = 10 is sufficient for either options UE is assigned both UL/DL traffic or only one traffic. |

#### ***Initial proposal 2-3-4:***

For UE clustering distribution of Urban Macro and Dense Urban Macro layer, select one of the two alternatives.

* Alt-1: *X*=1, Indoor UEs height: 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8)
* Alt-2: X=2, Indoor UEs height: 1.5m

Companies are encouraged to provide comments in the table below.

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| --- | --- |
| **Company** | **Comment** |
| ZTE | We support Alt-2.  If UEs are in different floors, the penetration loss between UEs will negate the necessity of simulating UE-UE interference. |
| Huawei, HiSilicon | We cannot live with Alt-1. The purpose of UE clustering is to achieve real UE-UE CLI through letting UEs are allocated closely to each other. However, UEs allocated in different floors in a building will violates this purpose. For example, UE allocated in different floor will lead to extra penetration loss, and the distance between UEs will be longer.  For Alt-2, X = 1 should also be considered. |
| Sony | Alt-2. |
| MediaTek | We can’t accept Alt-1 for the same reasons highlighted by HW. Not sure why we have only these two alternatives. We propose in our Tdoc the following “UEs in the same cluster deployed on the same floor, and the floor for the cluster is selected randomly. Multiple clusters can be deployed in a building”. |
| New H3C | Fine with Alt.2 |
| Ericsson | Alt-2.  One of the main potential benefits of SBFD is coverage enhancements. There are basically two reasons a UE can be in poor coverage, either it is very far away from the base station, or it is indoors, i.e., suffers from shadowing and penetration loss. To study the benefits of SBFD, sufficiently many UEs should be in poor coverage. In our opinion, the most relevant scenario for this is an urban macro deployment with a high proportion of indoor users, i.e., Clustering. Now, if we assume that the users within a cluster are in different floors as in Alt 1, they will be subject to wall penetration losses, and it defeats the whole purpose of clustering.  Furthermore, in Alt 2, why is X different from Alt 1? We support X=1 as we do not need to simulate more than 1 cluster. As pointed out before, if we have many clusters, we are distributing the 10 UEs per macro cell into multiple cluster groups, which also defeats the purpose of clustering. |
| QC | For Alt 1 (X=1), we think all UEs should be on first floor (UE heights 1.5 meter).  In addition, as discussed in our contribution, a single floor-loss for FR1 is at least 25 dB which will mask any inter-UE CLI. |

#### ***Initial proposal 2-3-5:***

For UE clustering distribution of Urban Macro and Dense Urban Macro layer,

* Dmacro-to-cluster = 60m (i.e., 35m+R), Dinter-cluster = 50 m, R = 25 m

Companies are encouraged to provide comments in the table below.

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| --- | --- |
| **Company** | **Comment** |
| ZTE | We propose to have different values for Urban Macro and Dense Urban Macro considering the different minimum distance between Macro and UE. To ensure the same minimum distance between Macro and UE, the following values can be adopted.   * For Urban Macro: Dmacro-to-cluster = 60m (i.e., 35m+R), Dinter-cluster = 50 m, R = 25 m * For Dense Urban Macro: Dmacro-to-cluster = 35m (i.e., 10m+R), Dinter-cluster = 50 m, R = 25 m   In addition, it is also worth noting that if UE cluster is simulated, it should be simulated in both legacy TDD and SBFD scenarios for fair comparison. |
| Huawei, HiSilicon | Fine. |
| MediaTek | We can’t accept R = 25. We such large radius, the UEs being close together is very unlikely. The cluster radius should be related to the number of UE per cluster. We propose the following: ***R* = (*n*+1)/2 meters**, where *n* is the number of UEs in the cluster. |
| Ericsson | We need a proposal for the number of clusters X, before we can decide on these values but in general ok with the proposal. |
| New H3C | Support |
| QC | Support.  It is good to clarify that the cluster is totally confined within the macro cell geographical area (i.e. whether a cluster can partial overlap with adjacent cell area). |

#### ***Initial proposal 2-3-6:***

Regarding random and uniform UE distribution in Dense Urban Macro layer scenario and Dense Urban Micro layer scenario for FR2-1, consider the following for UE outdoor/indoor proportion:

* Baseline: 100% Outdoor in cars: 30km/h
* Optional: 20% Outdoor in cars: 30km/h, 80% Indoor in houses: 3km/h
  + Outdoor UEs: 1.5 m;
  + Indoor UEs: 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8)

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | The second bullet is the typical simulation assumptions. We propose to either 1) mark the second bullet as baseline or 2) mark both of them as optional. |
| Huawei, HiSilicon | Fine. |
| Ericsson | What is the motivation to have baseline as Outdoor with all UEs in cars? If we assume all UEs are in cars, car penetration losses will prevent any scenario where UE-UE CLI maybe dominant. Instead, we prefer no cars with 3 km/h. |
| New H3C | Support |
| QC | Support in principle. Similar views as Ericsson, we support to study 3km/h for outdoor UEs. |

#### ***Initial proposal 2-3-7:***

Regarding layout of 2-layer Scenario B (HetNet with Urban Macro and Indoor),

* Layer 1: Urban Macro
  + Hexagonal grid with 7 macro sites and 3 sectors per site with wrap around, ISD=500m
* Layer 2:
  + One building randomly dropped per macro cell with random orientation.
    - For Indoor office, 3 TRPs per 120m x 50m
    - For Indoor factory, companies to report the detailed evaluation parameters for InF.
  + The minimum distance between macro TRP to indoor building center: 100m

Companies are encouraged to provide comments in the table below.

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| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | For Layer 2, it is enough to consider only one building throughout the macro geographical area. It can simplify the simulation and reduce the simulation time compared with dropping multiple buildings. And there is no difference for the evaluation results between dropping one building and multiple buildings because the interferences between multiple buildings are small enough and can be ignored.  In addition, only 3 TRPs for Indoor office cannot reflect the actual deployment scenario. So for Indoor office, 12 TRPs per (m) is preferred. |
| Sony | Fine with the proposal. |
| Ericsson | We have the exact same views as Huawei.   1. What is the motivation to have one building per macro cell? In the TR 38.828 one building per Macro was assumed to evaluate Indoor-Macro interference impact, so it made sense to assume more Indoor buildings. We also propose only one Indoor office building with 12 TRPs to reduce simulation overload. 2. Furthermore, an Urban Macro with ISD 500 m (Initial Proposal 2-3-7) seems a bit too much as there are penetration losses to the indoor system in addition to the distance between Macro BSs. If the intention is to evaluate inter-layer interference to see the impact from legacy to SBFD system, it would be more interesting to reduce the ISD in an Urban Macro scenario or consider a Dense Urban Macro Scenario  ***Initial proposal 2-3-7:*** Regarding layout of 2-layer Scenario B (HetNet with Urban Macro and Indoor),   * Layer 1: Urban Macro / Dense Urban Macro Layer   + Hexagonal grid with 7 macro sites and 3 sectors per site with wrap around, ISD=[ 500m / 200m] * Layer 2:   + One building randomly dropped in the macro geographical area.~~per macro cell with random orientation~~.     - For Indoor office, ~~3~~ 12 TRPs per 120m x 50m     - For Indoor factory, companies to report the detailed evaluation parameters for InF.   + ~~The minimum distance between macro TRP to indoor building center: 100m~~ |
| New H3C | Support |
| QC | For the random building dropping, whether the building has to be confined within the macro cell area or not. |

#### ***Initial proposal 2-3-8:***

Regarding UE distribution of 2-layer Scenario B (HetNet with Urban Macro and Indoor),

* 30 users per macro geographical area (per direction), 20 UEs are randomly and uniformly dropped within the building, and 10 UEs are randomly and uniformly dropped in the macro geographical area outside the building.
  + UE height for both indoor and outdoor: 1.5m
  + UEs dropped within the building are indoor with 3km/h; UEs dropped outside the building are outdoor in car with 30km/h
* FFS:
  + Whether the UE in the indoor office/indoor factory can select the Macro cell as serving cell or not.
  + Whether the UE outside the indoor office/indoor factory can select the indoor TRP as serving cell or not.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | Considering the simulation load, it would be better to reduce the number of UEs. For example, 21 UEs per macro geographical area, 14 UEs within the building and 7 UEs outside the building. |
| Huawei, HiSilicon | We think the following UE distribution is better.   * Urban Macro layer:   + 10 users per macro TRP, and all users are randomly and uniformly dropped within the macro cell;   + 20% outdoor in cars: speed with 30km/h, height with 1.5m;   + 80% indoor in houses: speed with 3km/h, height with 3(nfl – 1) + 1.5; nfl ~ uniform(1, Nfl) where Nfl ~ uniform(4,8); * Indoor office layer:   + 10 users per pico TRP, and all users are randomly and uniformly dropped within the pico cell;   + 100% indoor in houses: speed with 3km/h, height with 1.5m * UE selected Macro cell or indoor TRP is determined based on the RSRP, i.e., the UE in the indoor office/indoor factory can select the Macro cell as serving cell, and the UE outside the indoor office/indoor factory can select the indoor TRP as serving cell |
| Ericsson | We can assume the same number of users as the Urban Macro single layer case. 30 users is a lot and would increase the simulation time.  We do not see a need to model car penetration loss for all the UEs that are outdoors. |
| QC | Support. The 30 users per cluster is bit large overhead for simulation. Instead, we can say M users where 2/3 within the building and rest 1/3 within he macro area. |

## Issue#2-4: SBFD subband and slot configurations

### Submitted proposal

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| --- | --- |
| **Company** | **Proposals** |
| CMCC | ***Proposal 16:*** For performance evaluation and comparison between baseline legacy TDD operation and SBFD operation under SBFD Deployment Case 1, make the following update for Alt 3:   * Alt 3 (strive for the same UL/DL resource ratio between Legacy TDD and SBFD):   + Legacy TDD: Static TDD UL/DL configuration with {DDSUU}, where S=[12D:2G:0U]   + SBFD: Frame structure#2 (XXXXU), where X denotes a SBFD slot. In time domain, SBFD UL subband spans all the symbols in a SBFD slot. In frequency domain, SBFD UL subband is about 25% of the channel bandwidth.   ***Proposal 17:*** For SBFD evaluation, the guard band size (i.e. NG) should be reported by companies.   * For SLS calibration purpose, SBFD Subband configuration#1 with {DUD} pattern is assumed.   + Alt 1/2/4 (SBFD UL subband is about 20% of the channel bandwidth):     - For FR1 with 100MHz channel bandwidth and 30kHz SCS (273 PRB): < ND, NU,NG > = <104, 55, 5>     - For FR2 with 100MHz channel bandwidth and 120kHz SCS (66 PRB) < ND, NU,NG > = <25, 14, 1>   + Alt 3 (SBFD UL subband is about 25% of the channel bandwidth):     - For FR1 with 100MHz channel bandwidth and 30kHz SCS (273 PRB): < ND, NU,NG > = <97, 69, 5>     - For FR2 with 100MHz channel bandwidth and 120kHz SCS (66 PRB) < ND, NU,NG > = <24, 16, 1>   ***Proposal 18:*** For SBFD evaluation, companies should report the guard symbols assumed in the SBFD operation.  ***Proposal 19:*** For performance evaluation and comparison between baseline legacy TDD operation and SBFD operation under SBFD Deployment Case 3-2, consider the following assumption:   |  |  |  | | --- | --- | --- | |  | **Layer 1** | **Layer 2** | | **Legacy TDD operation (Baseline for comparison with SBFD Deployment Case 3-2)** | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] | | **SBFD Deployment Case 3-2** | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] | SBFD: Frame structure#2 (XXXXU), where X denotes a SBFD slot. In time domain, SBFD UL subband spans all the symbols in a SBFD slot. In frequency domain, SBFD UL subband is about 20% of the channel bandwidth. |   ***Proposal 20:*** For performance evaluation and comparison between baseline legacy TDD operation and SBFD operation under SBFD Deployment Case 4, consider the following assumption:   |  |  |  | | --- | --- | --- | |  | **Operator#1** | **Operator#2** | | **Legacy TDD operation (Baseline for comparison with SBFD Deployment Case 4)** | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] | | **SBFD Deployment Case 4** | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] | SBFD: Frame structure#2 (XXXXU), where X denotes a SBFD slot. In time domain, SBFD UL subband spans all the symbols in a SBFD slot. In frequency domain, SBFD UL subband is about 20% of the channel bandwidth. | |
| ZTE | ***Proposal 11****: For SBFD simulation, in case of direction switching for one certain antenna panel, a switching gap is needed.*   * *The switching gap can be 1 symbol or 2 symbols, which is up to company to report.*   ***Proposal 13****: Consider the following slot format traffic model for dynamic TDD simulation.*   * *Note: different traffic models for Macro and Micro/Indoor office can also be considered.*  |  |  | | --- | --- | | TDD Case | Traffic model | | Legacy TDD  DDDSU, S=[10:2:2] | Burst buffer with FTP traffic model 3 (packet size = 0.1, 0.5, and 2.0 MB)  - Average Ratio of DL/UL traffic = {3:1}  - λd/ λu = 20/7, 30/9 or 40/11 | | Dynamic TDD  DDDSU (Marco)+  DSUUU(small cell)  S=[10:2:2] | Macro: Burst buffer with FTP traffic model 3 (packet size = 0.1, 0.5, and 2.0 MB)  - Average Ratio of DL/UL traffic = {3:1}  - λd/ λu = 20/7, 30/9 or 40/11  Small cell: Burst buffer with FTP traffic model 3 (packet size = 0.1, 0.5, and 2.0 MB)  - Ratio of DL/UL traffic = {3:1}  - λd/ λu = 20/7, 30/9 or 40/11 | |
| Ericsson | Proposal 1: A SBFD carrier shall have a carrier BW and a UL subband BW consistent with one of the existing supported carrier BW in RAN4 specs.  Proposal 15: For the TDD configuration for Case 3-2 and Case 4, the following needs to be considered   1. Baseline: All gNBs in both layers and both operators use a common static TDD configuration: DDDSU 2. Option 1: All gNBs in Layer1/Operator 1 uses a static TDD configuration: DDDSU. All gNBs in Layer2/Operator 2 uses a SBFD configuration XXXSU or a flexible TDD configuration FFFFU. 3. Option 2: All gNBs in Layer1/Operator 1 uses a static TDD configuration: DDDSU. All gNBs Layer2/Operator 2 uses a SBFD configuration XXXXX or a flexible TDD configuration FFFFF. 4. Option 3: All gNBs in Layer1/Operator 1 uses a static TDD configuration: DDDSU. All gNBs in layer 2/Operator 2 use legacy static TDD operation with the same UL dominant static TDD UL/DL configuration.    * 1. FFS: UL dominant static TDD UL/DL configuration based on realistic deployments.   Proposal 26: For SBFD evaluations with configuration XXXXU, RAN1 to agree to change the time domain pattern to XXXSU where S includes 2 guard symbols and 12 OFDM symbols in the SBFD slot.  Proposal 27: RAN1 to agree to the following regarding SBFD configuration for FR1   * 1. For SBFD evaluation, the guard band size (i.e. NG) should be reported by companies.   2. For SLS calibration purpose, SBFD Subband configuration#1 with {DUD} pattern is assumed.   3. SBFD UL subband is about 20% of the channel bandwidth:      1. For FR1 with 100MHz channel bandwidth and 30kHz SCS (273 PRB): < ND, NU, NG > = <106, 51, 5>.   Observation 7: SBFD configuration with 20% channel bandwidth was assumed for a 40-20-40 DUD configuration in FR1 and the assumptions in RAN4 are based on this configuration. It will impact the link level and feasibility studies if we change this configuration to 25%.  Proposal 28: RAN1 to agree to modify Alt 3 as following-   1. For performance evaluation and comparison between baseline legacy TDD operation and SBFD operation under SBFD Deployment Case 1, make the following update for Alt 3: 2. Alt 3 (strive for the same UL/DL resource ratio between Legacy TDD and SBFD): 3. Legacy TDD: Static TDD UL/DL configuration with {DU’DDU’}, where U’=[0D:2G:12U], the switching slots are in the UL slot denoted as U’ 4. SBFD: Frame structure#2 (XXXXU), where X denotes a SBFD slot. In time domain, SBFD UL subband spans all the symbols in a SBFD slot. In frequency domain, SBFD UL subband is about 20% of the channel bandwidth.   Proposal 29: RAN1 to agree to further down-select Alt2 and Alt3 (with the proposed DU’DDU’ configuration) for system level simulations.  Proposal 30: RAN1 to agree on the same TDD configurations for performance evaluation of coexistence cases (Case 4) as was agreed for the non-coexistence single operator case (Case 1).  Proposal 31: RAN1 to agree a separate SBFD subband configuration for FR2. For FR2 with 200MHz channel bandwidth and 120kHz SCS (132 PRB): < ND, NU,NG > = <47, 32, 3>. |
| Qualcomm | **Observation 8: Alt 4 and Alt 3 represent fair comparison between SBFD and TDD in terms of DL and UL resources.**  **Observation 9: For SLS evaluation, SBFD is transparent to the UE where all slots are flexible from UE perspective. gNB dynamically schedules the UE within the UL or DL subbands of the SBFD slot.**   * **Full band CSI (SRS and CSI-RS) can be enabled at some non-SBFD symbols**   **Proposal 17: For FR2, for legacy TDD deployment scenario and subband full duplex deployment scenario,**   * **Support periodic reserved DL-only slots and UL-only slots for common control channels**   + **E.g. 20 slots per 20 ms for SSB, 20 slots per 160 ms for PRACH**   **Proposal 18: For subband full duplex deployment scenario, support configurable ND RBs DL subbands, NU RBs UL subbands and NG RBs as the gap between the DL and UL subbands**   * **Support ~40% RBs for each of the two DL subbands (ND=2x~40% RBs) and ~20% RBs for UL subband in middle (NU=~20% RBs) and N RBs guard band in between**   + **N (6 RBs for 30 KHz and 1 RB for 120KHz) or 0 RB for the gap between DL and UL subbands (NG=2xN or 0 RB)** |
| DOCOMO | **Proposal 1: For the number of PRBs for SBFD with DL-UL-DL subbands,** **UL subband with 55 RBPs for FR1 and 14 PRBs for FR2 and guardband with 5 PRBs for both FR1 and FR2 are used for the evaluation.** |
| Xiaomi | **Observation 1: For alt 3 and alt 4 under umbrella of SBFD Deployment Case 1,**   * **It restricts the uplink transmission on the UL symbols with confining available UL resources within UL subband.** * **The same UL/DL resource ratio between Legacy TDD and SBFD degrades or even eliminate the potential benefits of SBFD.** * **System performance is further degraded due to the guard band between UL subband and DL subband on UL slot.** |
| Spreadtrum | ***Proposal 20: UL subband size and guardband size should follow the guidance of RAN4, but at the first stage it can be down-selected from those three options.*** |
| InterDigital | ***Proposal 3.*** *Study performance of applying a frequency gap or guard RBs for a UL transmission in an SBFD framework for interference mitigation with regards to adjacent DL subbands.* |
| Intel | **Proposal 12:**   * **For the agreement related to the time domain allocations for SBFD, the following update should be applied to Alt 3:**    + **Alt 3 (strive for the same UL/DL resource ratio between Legacy TDD and SBFD):**      - **Legacy TDD: Static TDD UL/DL configuration with {DDSUU}, where S=[12D:2G:0U]**     - **SBFD: Frame structure#2 (XXXXU), where X denotes a SBFD slot. In time domain, SBFD UL subband spans all the symbols in a SBFD slot. In frequency domain, SBFD UL subband is about [~~20%~~ 25%] of the channel bandwidth.**   **Proposal 13: For calibration purpose, the following SBFD sub-band configurations are assumed:**   * **Alt 1/2/4 (SBFD UL subband is about 20% of the channel bandwidth):**    + **For FR1 with 100MHz channel bandwidth and 30kHz SCS < ND, NU, NG > = <104, 55, 5>**   + **For FR2 with 100MHz channel bandwidth and 120kHz SCS < ND, NU, NG > = <25, 14, 1>** * **Alt 3 (SBFD UL subband is about 25% of the channel bandwidth):**   + **For FR1 with 100MHz channel bandwidth and 30kHz SCS: < ND, NU, NG > = <97, 69, 5>**   + **For FR2 with 100MHz channel bandwidth and 120kHz SCS < ND, NU, NG > = <24, 16, 1>** |

### Summary

Regarding the four alternatives for performance evaluation and comparison between baseline legacy TDD operation and SBFD operation under SBFD Deployment Case 1, two companies [Intel, CMCC] suggest to make the following update for Alt 3:

* Alt 3 (strive for the same UL/DL resource ratio between Legacy TDD and SBFD):
  + Legacy TDD: Static TDD UL/DL configuration with {DDSUU}, where S=[12D:2G:0U]
  + SBFD: Frame structure#2 (XXXXU), where X denotes a SBFD slot. In time domain, SBFD UL subband spans all the symbols in a SBFD slot. In frequency domain, SBFD UL subband is about 25% of the channel bandwidth.

However, Ericsson thinks SBFD configuration with 20% channel bandwidth was assumed for a 40-20-40 DUD configuration in FR1 and the assumptions in RAN4 are based on this configuration. It will impact the link level and feasibility studies if we change this configuration to 25%. Ericsson suggests RAN1 to agree to modify Alt 3 as following:

* Alt 3 (strive for the same UL/DL resource ratio between Legacy TDD and SBFD):
  + Legacy TDD: Static TDD UL/DL configuration with {DU’DDU’}, where U’=[0D:2G:12U], the switching slots are in the UL slot denoted as U’
  + SBFD: Frame structure#2 (XXXXU), where X denotes a SBFD slot. In time domain, SBFD UL subband spans all the symbols in a SBFD slot. In frequency domain, SBFD UL subband is about 20% of the channel bandwidth.

In addition, Ericsson thinks that there is a need to down-select alternatives to reduce the workload for RAN1 as there are many simulation scenarios with multiple configurations. Ericsson suggests RAN1 to agree to further down-select Alt2 and Alt3 (with the proposed DU’DDU’ configuration) for system level simulations. Considering there is different views on update of Alt 3, and both Alt 3 and Alt 4 aim to the same UL/DL resource ratio between Legacy TDD and SBFD, moderator suggests to deprioritize Alt 3.

Moderator suggests **Initial proposal 2-4-1** based on the submitted proposals.

Three companies [Ericsson, Intel, CMCC] suggest the guard band size (i.e. NG) to be reported by companies for SBFD evaluation, and for SLS calibration purpose, SBFD Subband configuration#1 with {DUD} pattern is assumed. But regarding the value of < ND, NU,NG >, companies have different views.

Ericsson suggests a SBFD carrier shall have a carrier BW and a UL subband BW consistent with one of the existing supported carrier BW in RAN4 specs, and for the case that SBFD UL subband is about 20% of the channel bandwidth, the following is considered:

* For FR1 with 100MHz channel bandwidth and 30kHz SCS (273 PRB): < ND, NU,NG > = <106, 51, 5>
* For FR2 with 200MHz channel bandwidth and 120kHz SCS (132 PRB): < ND, NU,NG > = <47, 32, 3>

DoCoMo suggests UL subband with 55 RBPs for FR1 and 14 PRBs for FR2 and guardband with 5 PRBs for both FR1 and FR2 are used for the evaluation.

Two companies [Intel, CMCC] suggest the following:

* + Alt 1/2/4 (SBFD UL subband is about 20% of the channel bandwidth):
    - For FR1 with 100MHz channel bandwidth and 30kHz SCS (273 PRB): < ND, NU,NG > = <104, 55, 5>
    - For FR2 with 100MHz channel bandwidth and 120kHz SCS (66 PRB) < ND, NU,NG > = <25, 14, 1>
  + Alt 3 (SBFD UL subband is about 25% of the channel bandwidth):
    - For FR1 with 100MHz channel bandwidth and 30kHz SCS (273 PRB): < ND, NU,NG > = <97, 69, 5>
    - For FR2 with 100MHz channel bandwidth and 120kHz SCS (66 PRB) < ND, NU,NG > = <24, 16, 1>

The corresponding UL/DL resource ratios for the above baseline configuration for four alternatives are summarized as follows.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Frame structure** | **<DL:UL:SBFD (X) > symbol#** | **SBFD configurations** | **< ND, NU, NG >** | **The ratio of SBFD UL subband over channel bandwidth** | **UL/DL resource ratio considering guard band** |
| **Alt 2** | legacy TDD | DDDSU, S=[12D:2G:0U] | <54, 14, 0> |  |  |  | 25.9% |
| SBFD | XXXXU | <0, 14, 56> | DUD for FR1 | <104, 55, 5> | 20.1% | 59.3% |
| DUD for FR2-1 | <25, 14, 1> | 21.2% | 61.0% |
| **Alt 4 (same UL/DL resource ratio)** | legacy TDD | DDDSU, S=[12D:2G:0U] | <54, 14, 0> |  |  |  | 25.9% |
| SBFD | XXXXX | <0, 0, 70> | DUD for FR1 | <104, 55, 5> | 20.1% | 26.4% |
| DUD for FR2-1 | <25, 14, 1> | 21.2% | 28.0% |
| **Alt 1** | legacy TDD | DDDSU, S=[12D:2G:0U] | <54, 14, 0> |  |  |  | 25.9% |
| SBFD | DXXXU | <14, 14, 42> | DUD for FR1 | <104, 55, 5> | 21.2% | 48.6% |
| DUD for FR2-1 | <25, 14, 1> | 21.2% | 50.0% |
| **Alt 3 (same UL/DL resource ratio)** | legacy TDD | DDSUU, S=[12D:2G:0U] | <40, 28, 0> |  |  |  | 70.0% |
| SBFD | XXXXU | <0, 14, 56> | DUD for FR1 | <97, 69, 5> | 25.3% | 70.7% |
| DUD for FR2-1 | <24, 16, 1> | 24.2% | 67.7% |

From moderator’s perspective, the first question needs to be answered is whether to revise the system bandwidth assumption agreed in RAN1#110 from 100MHz to 200MHz for FR2-1. If companies agree, then we can discuss Ericsson’s proposal to use < ND, NU,NG > = <47, 32, 3> for FR2 with 200MHz channel bandwidth and 120kHz SCS (132 PRB).

Moderator suggests **Initial proposal 2-4-2** and **Initial question 2-4-3**.

Regarding the guard symbols assumed in the SBFD operation,

* CMCC suggests companies to report the guard symbols.
* ZTE suggests the switching gap can be 1 symbol or 2 symbols, which is up to company to report.
* Ericsson suggests for SBFD evaluations with configuration XXXXU, RAN1 to agree to change the time domain pattern to XXXSU where S includes 2 guard symbols and 12 OFDM symbols in the SBFD slot.

Moderator suggests **Initial proposal 2-4-4** based on the submitted proposals.

Regarding Deployment Case 3-2 and SBFD Deployment Case 4, Ericsson suggests to reuse the SBFD Frame structures in Alt2(XXXXU) and Alt4(XXXXX) agreed for Deployment Case 1, , CMCC suggests to reuse the SBFD Frame structures in Alt2(XXXXU) agreed for Deployment Case 1.

|  |  |  |
| --- | --- | --- |
|  | **Layer 1 for Case 3-2/ Operator 1 for case 4** | **Layer 2 for case 3-2 / Operator 2 for case 4** |
| **Legacy TDD operation (Baseline for comparison with SBFD Deployment Case 3-2 or Case 4)** | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] |
| **SBFD Deployment Case 3-2 or Case 4** | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] | * Reuse the SBFD Frame structures in Alt2(XXXXU) agreed for Deployment Case 1   + Ericsson * Reuse the SBFD Frame structures in Alt4(XXXXX) agreed for Deployment Case 1   + Ericsson, CMCC |

Moderator suggests **Initial proposal 2-4-5.**

### 1st Round Proposals

#### ***Initial proposal 2-4-1:***

For performance evaluation and comparison between baseline legacy TDD operation and SBFD operation under SBFD Deployment Case 1, Alt 3 is deprioritized.

* Alt 3 (strive for the same UL/DL resource ratio between Legacy TDD and SBFD):
  + Legacy TDD: Static TDD UL/DL configuration with {DDSUU}, where S=[12D:2G:0U]
  + SBFD: Frame structure#2 (XXXXU), where X denotes a SBFD slot. In time domain, SBFD UL subband spans all the symbols in a SBFD slot. In frequency domain, SBFD UL subband is about 20% of the channel bandwidth.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | From our perspective, Alt.3 shouldn’t be deprioritized for the following reasons.  1) both Alt.3 and Alt.4 can ensure the same UL/DL resource ratio. However, Alt.3 with XXXXU has a legacy U slot, it is critical to have a legacy U slot especially for cell edge UEs. Alt.4 with XXXXX doesn’t have legacy U slot.  2) The interference is frequency flat, whether the UL subband occupies 20% or 25% of the total bandwith may not have much difference.  3) We have already provided some simulation results for Alt.3. We will also provide simulation results for other alternatives in the future but we are not ok to deprioritize Alt.3 at this point.  From our perspective, we can just update the following percentage. Then that’s it.   * *Alt 3 (strive for the same UL/DL resource ratio between Legacy TDD and SBFD):*    + *Legacy TDD: Static TDD UL/DL configuration with {DDSUU}, where S=[12D:2G:0U]*   + *SBFD: Frame structure#2 (XXXXU), where X denotes a SBFD slot. In time domain, SBFD UL subband spans all the symbols in a SBFD slot. In frequency domain, SBFD UL subband is about* ***25****% of the channel bandwidth.* |
| Huawei, HiSilicon | Support. We believe Alt.1, Alt.2 and Alt.4 covers a range of different SBFD configurations including both same UL/DL resource ratio. |
| Sony | Fine with the proposal. There are too many scenarios already, good to deprioritise some of them. |
| Ericsson | We support this proposal. |
| New H3C | Support |

#### ***Initial proposal 2-4-2:***

For SLS calibration purpose, SBFD Subband configuration#1 with {DUD} pattern is assumed.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We support this proposal. |
| Huawei, HiSilicon | OK. |
| Sony | Fine with the proposal. |
| Ericsson | Ok to support. |
| New H3C | Support |
| QC | Support |

#### ***Initial question 2-4-3:***

Whether to revise the channel bandwidth assumption from 100MHz to 200MHz for FR2-1? Whether a SBFD carrier shall have a carrier BW and a UL subband BW consistent with one of the existing supported carrier BW in RAN4 specs? E.g., 51 RBs are used for UL subband for FR1 and 32 RBs are used for UL subband for FR2 as below.

* For FR1 with 100MHz channel bandwidth and 30kHz SCS (273 PRB): < ND, NU,NG > = <106, 51, 5>
* For FR2 with 200MHz channel bandwidth and 120kHz SCS (132 PRB): < ND, NU,NG > = <47, 32, 3>

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | * We are ok to revise the channel bandwidth assumption from 100MHz to 200MHz for FR2-1. * Regarding whether a SBFD carrier shall have a carrier BW and a UL subband BW consistent with one of the existing supported carrier BW in RAN4 specs, we don’t have a strong view. But from our perspective, we don’t need to choose these specific number of RBs in the simulation, it won’t cause much difference in simulation. * For FR1 with 100MHz channel bandwidth and 30kHz SCS (273 PRB), we propose the following two candidates.   For UL subband with about 20% of the channel bandwidth, < ND, NU,NG > = <106, 51, 5>  For UL subband with about 25% of the channel bandwidth, < ND, NU,NG > = <96, 69, 6> |
| Huawei, HiSilicon | Fine to revise the channel bandwidth assumption from 100MHz to 200MHz for FR2-1.  On whether a SBFD carrier shall have a carrier BW and a UL subband BW consistent with one of the existing supported carrier BW in RAN4 specs, we share the similar view with ZTE that the specific number of RBs does not make a big difference. |
| Sony | For FR1, using 51 RB for UL subband out of 273 RBs would give only 18.6% instead of the targeted 20%. We suggest using <104, 53, 6>, giving 19.4% UL, to bring the number closer to the targeted 20% value. |
| Ericsson | We support the proposal. The intention is to get realistic gains of SBFD based on existing configurations. |
| New H3C | Fine with HW ‘s modification |
| QC | * For FR2, 100 MHz was agreed as baseline for SLS evaluation. Propose to stick to the agreement. * For Evaluation, UL-SB doesn’t need to map to RAN4 specified channel BW. * For FR2, support small number of RBs as guard band, 0 or 1 RB. |

#### ***Initial proposal 2-4-4:***

For SBFD evaluation, companies should report the guard symbols assumed in the SBFD operation.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We support to add some example values to avoid too much fragmentation.  For SBFD evaluation, companies should report the guard symbols assumed in the SBFD operation.   * 1 or 2 symbols gap as baseline, other values are not precluded. |
| Huawei, HiSilicon | Fine. |
| Sony | It will be good to define some values to have closer calibration among companies, e.g. just use 1 symbol gap for guard period. |
| Ericsson | We support the proposal. |
| New H3C | Support |
| QC | Support |

#### ***Initial proposal 2-4-5:***

For performance comparison between baseline legacy TDD network and SBFD Deployment Case 3-2 or SBFD Deployment Case 4, consider the following assumptions.

|  |  |  |
| --- | --- | --- |
|  | **Layer 1 for Case 3-2/ Operator#1 for case 4** | **Layer 2 for case 3-2 / Operator#2 for case 4** |
| **baseline legacy TDD network (Baseline for comparison with SBFD Deployment Case 3-2 or Case 4)** | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] |
| **SBFD Deployment Case 3-2 or Case 4** | Static TDD UL/DL configuration with {DDDSU}, where S=[12D:2G:0U] | * Reuse the SBFD Frame structures in Alt2(XXXXU) agreed for Deployment Case 1 * FFS: whether to use the SBFD Frame structures in Alt4(XXXXX) agreed for Deployment Case 1 |

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | For layer 2 with SBFD deployment Case 3-2 or Case 4, Alt 1, 2 and 4 should all be evaluated. |
| Sony | Fine with the proposal. |
| Ericsson | We support the proposal |
| New H3C | Support |
| QC | For SBFD deployment case 3-2 or case 4, we support Alt4 as baseline. |

## Issue#2-5: Traffic model

### Submitted proposal

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| CMCC | ***Proposal 21:*** Adopt the following table for traffic model of FTP model 3 for scenarios in deployment case 1 for SBFD.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | Indoor office (FR1&FR2) | Urban Macro (FR1) | Dense Urban Macro layer (FR1&FR2) | Dense Urban Micro layer (FR2) | Dense Urban with 2-layer (FR1) | | General | UL and DL are simulated simultaneously. Companies to report which option is used.   * Option 1: 2*M* users per TRP. Each UE is either assigned UL traffic or DL traffic.   + assume the same number of UEs for UL and DL, i.e., *M* UE are assigned UL traffic, and *M* UE are assigned DL traffic. * Option 2: *M* users per TRP. Each UE is assigned both UL traffic and DL traffic. | | | | | | FTP packet size | Both symmetric and asymmetric packet size for UL and DL can be considered. Companies to report which option is used.   * Option 1: Symmetric packet size:   + 1Kbyte for DL/UL, 0.1Mbytes for DL/UL, 0.5Mbytes for DL/UL, 2Mbytes for DL/UL * Option 2: Asymmetric packet size:   + 4Kbytes for DL and 1Kbyte for UL, 0.5Mbyte for DL and 0.125 Mbytes for UL | | | | | | UL arrival rate for legacy TDD | * The UL arrival rate is selected to reach a target UL traffic load (RU). * UL Traffic load: low UL RU ([<10%]), medium UL RU ([20%-30%]), and high UL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | | | * The UL arrival rate#1 of Macro cell and UL arrival rate#2 of Micro cell are selected to reach target UL traffic load (RU)#1 of Macro cell and target UL traffic load (RU)#2 of Micro cell, respectively * UL Traffic load: low UL RU ([<10%]), medium UL RU ([20%-30%]), and high UL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | DL arrival rate for legacy TDD | * The DL arrival rate is selected to reach a target DL traffic load (RU). * DL Traffic load: low DL RU ([<10%]), medium DL RU ([20%-30%]), and high DL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | | | * The DL arrival rate#1 of Macro cell and DL arrival rate#2 of Micro cell are selected to reach target DL traffic load (RU)#1 of Macro cell and target DL traffic load (RU)#2 of Micro cell, respectively * DL Traffic load: low DL RU ([<10%]), medium DL RU ([20%-30%]), and high DL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | Arrival rate for SBFD | The UL and DL FTP packet arrival rate for SBFD are the same as legacy TDD. | | | | |   ***Proposal 22:*** Adopt the following table for traffic model for scenarios in SBFD deployment case 3-2.   |  |  |  |  | | --- | --- | --- | --- | |  | | **2-layer Scenario A** | **2-layer Scenario B** | | **General** | | Reuse the simulation assumption under SBFD Deployment Case 1. | | | **FTP packet size** | | Reuse the simulation assumption under SBFD Deployment Case 1. | | | **Arrival rate for legacy TDD operation (Baseline for comparison with SBFD Deployment Case 3-2)** | **UL arrival rate** | * The UL arrival rate#1 of TRP in Layer 1 and UL arrival rate#2 of TRP in Layer 2 are selected to reach target UL traffic load (RU)#1 of TRP in Layer 1 and target UL traffic load (RU)#2 of TRP in Layer 2, respectively * UL Traffic load: low UL RU ([<10%]), medium UL RU ([20%-30%]), and high UL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | | **DL arrival rate** | * The DL arrival rate#1 of TRP in Layer 1 and DL arrival rate#2 of TRP in Layer 2 are selected to reach target DL traffic load (RU)#1 of TRP in Layer 1 and target DL traffic load (RU)#2 of TRP in Layer 2, respectively * DL Traffic load: low DL RU ([<10%]), medium DL RU ([20%-30%]), and high DL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | | **Arrival rate for SBFD Deployment Case 3-2** | | The UL and DL FTP packet arrival rate for each layer are kept the same as that for the legacy TDD operation. | |   ***Proposal 23:*** Adopt the following table for traffic model for SBFD deployment case 4.   |  |  |  |  | | --- | --- | --- | --- | |  | | **FR1: Urban Macro** | **FR2-1: Dense Urban Macro layer** | | **General** | | Reuse the simulation assumption under SBFD Deployment Case 1. | | | **FTP packet size** | | Reuse the simulation assumption under SBFD Deployment Case 1. | | | **Arrival rate for legacy TDD operation (Baseline for comparison with SBFD Deployment Case 4)** | **UL arrival rate** | * The UL arrival rate#1 of TRP for Operator#1 and UL arrival rate#2 of TRP for Operator#2 are selected to reach target UL traffic load (RU)#1 of TRP for Operator#1 and target UL traffic load (RU)#2 of TRP for Operator#2, respectively * UL Traffic load: low UL RU ([<10%]), medium UL RU ([20%-30%]), and high UL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | | **DL arrival rate** | * The DL arrival rate#1 of TRP for Operator#1 and DL arrival rate#2 of TRP for Operator#2 are selected to reach target DL traffic load (RU)#1 of TRP for Operator#1 and target DL traffic load (RU)#2 of TRP for Operator#2, respectively * DL Traffic load: low DL RU ([<10%]), medium DL RU ([20%-30%]), and high DL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | | **Arrival rate for SBFD Deployment Case 4** | | The UL and DL FTP packet arrival rate for each operator are kept the same as that for the legacy TDD operation. | |   ***Proposal 24:*** Adopt the following table for traffic model for dynamic/flexible TDD evaluation.   |  |  |  |  | | --- | --- | --- | --- | |  | | **1-layer scenario: Indoor office (FR1&FR2), Urban Macro (FR1), Dense Urban Macro layer (FR2)** | **2-layer Scenario A (FR1), 2-layer Scenario B (FR1)** | | **General** | | Reuse the simulation assumption under SBFD Deployment Case 1. | | | **FTP packet size** | | Reuse the simulation assumption under SBFD Deployment Case 1. | | | **Arrival rate for legacy TDD operation (Baseline for comparison with dynamic/flexible TDD)** | **UL arrival rate for legacy TDD** | * The UL arrival rate is selected to reach a target UL traffic load (RU). * UL Traffic load: low UL RU ([<10%]), medium UL RU ([20%-30%]), and high UL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | * The UL arrival rate#1 of TRP in Layer 1 and UL arrival rate#2 of TRP in Layer 2 are selected to reach target UL traffic load (RU)#1 of TRP in Layer 1 and target UL traffic load (RU)#2 of TRP in Layer 2, respectively * UL Traffic load: low UL RU ([<10%]), medium UL RU ([20%-30%]), and high UL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | **DL arrival rate** | * The DL arrival rate is selected to reach a target DL traffic load (RU). * DL Traffic load: low DL RU ([<10%]), medium DL RU ([20%-30%]), and high DL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | * The DL arrival rate#1 of TRP in Layer 1 and DL arrival rate#2 of TRP in Layer 2 are selected to reach target DL traffic load (RU)#1 of TRP in Layer 1 and target DL traffic load (RU)#2 of TRP in Layer 2, respectively * DL Traffic load: low DL RU ([<10%]), medium DL RU ([20%-30%]), and high DL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | **Arrival rate for dynamic/flexible TDD** | | The UL and DL FTP packet arrival rate for each layer are kept the same as that for the legacy TDD operation. | | |
| Huawei | ***Proposal 21:*** *For Deployment Case 4 and Het Net scenario for Deployment Case 3-2, reuse the traffic model of FTP model 3 for Dense Urban with 2-layer scenario in Deployment Case 1.* |
| ZTE | ***Proposal 12****: For simulation of SBFD deployment case 4,*   * *Different power levels in adjacent carriers can be simulated and it is up to company to report the power levels.* * *Different load levels in adjacent carriers can be simulated and consider the following as baseline.* * *for low load, the adjacent channel interference will be applied with 10% as the probability;* * *for medium load, the adjacent channel interference will be applied with 50% as the probability;* * *for high load, the adjacent channel interference will be applied with 100% as the probability* |
| Ericsson | Proposal 19: RAN1 to agree that the traffic load in system level simulations for two operator scenarios with same input traffic in both operators, is based on the system resource utilization for UL and DL based on the reference static TDD network.  Proposal20: RAN1 to agree that for co-existence evaluations (e.g. between two networks), further consider high input traffic in the aggressor network and low traffic in the victim network. |
| Samsung | *Proposal 6: To generate UEs with either DL traffic or UL traffic,*   * *The number of total UEs (including DL UE and UL UE) is doubled (compared to the case where each UE has both DL and UL traffic)* * *The DL UEs and DL UEs are distributed in clusters independently* |
| Qualcomm | **Proposal 12**: **Remove square bracket for the traffic load** (i.e., **low (<10%), medium (20%-40%) and high (~50%)).** |
| DOCOMO | **Proposal 2: Common parameters including power and load levels can be used for deployment case 1 and 4.** |
| Nokia | **Proposal 4: For the traffic model and load levels assumed in the evaluation of SBFD Deployment Case 4, assume FTP3 traffic model with similar settings as agreed for SBFD deployment Case 1.**   * **DL and UL arrival rates that reach low (<10%), medium (20-30%) and high (~50%) RU can be determined for the single operator legacy TDD case, and those low/medium/high arrival rates can be independently configured for each operator and link direction in the adjacent-channel simulations based on company’s preference.** |
| CATT | **Proposal 7: Reuse the agreed simulation assumptions which are applicable for other deployment cases and the detailed parameters of FTP model 3 of deployment case 1 for deployment case 4.** |
| Xiaomi | **Proposal 4: XR traffic models can be considered for SBFD and dynamic/flexible TDD evaluation.** |
| Spreadtrum | ***Proposal 18: Number of UEs per direction can be set for each scenarios for UE distribution.*** |
| Intel | **Proposal 10: For SBFD Deployment Case 4, at least the following combinations of loads should be considered across operators:**   |  |  |  | | --- | --- | --- | | **Combination** | **Operator #1 (TDD)** | **Operator #2 (SBFD)** | | **Case #1** | **High DL and UL RU** | **High DL and UL RU** | | **Case #2** | **High DL and UL RU** | **Medium DL and UL RU** | | **Case #3** | **Medium DL and UL RU** | **High DL and UL RU** | | **Case #4** | **Medium DL and UL RU** | **Medium DL and UL RU** | |

### Summary

In RAN1#110 meeting, agreement was achieved for traffic model of FTP model 3 for scenarios in deployment case 1 for SBFD.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agreement**  Adopt the following table for traffic model of FTP model 3 for scenarios in deployment case 1 for SBFD.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | Indoor office (FR1&FR2) | Urban Macro (FR1) | Dense Urban Macro layer (FR1&FR2) | Dense Urban Micro layer (FR2) | Dense Urban with 2-layer (FR1) | | General | UL and DL are simulated simultaneously. Companies to report which option is used.   * Option 1: Each UE is either assigned UL traffic or DL traffic.   + assume the same number of UEs for UL and DL, FFS the total number of UEs   + FFS how to handle the UE clustering case * Option 2: Each UE is assigned both UL traffic and DL traffic. | | | | | | FTP packet size | Both symmetric and asymmetric packet size for UL and DL can be considered. Companies to report which option is used.   * Option 1: Symmetric packet size:   + 1Kbyte for DL/UL, 0.1Mbytes for DL/UL, 0.5Mbytes for DL/UL, 2Mbytes for DL/UL * Option 2: Asymmetric packet size:   + 4Kbytes for DL and 1Kbyte for UL, 0.5Mbyte for DL and 0.125 Mbytes for UL | | | | | | UL arrival rate for legacy TDD | * The UL arrival rate is selected to reach a target UL traffic load (RU). * UL Traffic load: low UL RU ([<10%]), medium UL RU ([20%-30%]), and high UL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | | | * The UL arrival rate#1 of Macro cell and UL arrival rate#2 of Micro cell are selected to reach target UL traffic load (RU)#1 of Macro cell and target UL traffic load (RU)#2 of Micro cell, respectively * UL Traffic load: low UL RU ([<10%]), medium UL RU ([20%-30%]), and high UL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | DL arrival rate for legacy TDD | * The DL arrival rate is selected to reach a target DL traffic load (RU). * DL Traffic load: low DL RU ([<10%]), medium DL RU ([20%-30%]), and high DL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | | | * The DL arrival rate#1 of Macro cell and DL arrival rate#2 of Micro cell are selected to reach target DL traffic load (RU)#1 of Macro cell and target DL traffic load (RU)#2 of Micro cell, respectively * DL Traffic load: low DL RU ([<10%]), medium DL RU ([20%-30%]), and high DL RU ([~50%]). * Note: Type-2 RU definition (calculated per link direction) is used | | Arrival rate for SBFD | The UL and DL FTP packet arrival rate for SBFD are the same as legacy TDD. | | | | | |

Regarding the FFS on total number of UEs,

* Spreadtrum suggests the number of UEs per direction can be set for each scenario for UE distribution.
* Two companies [Samsung, CMCC] suggest UEs with either DL traffic or UL traffic, the number of total UEs (including DL UE and UL UE) is doubled (compared to the case where each UE has both DL and UL traffic).
* This issue has been considered in **initial proposal 2-3-3**

Regarding the FFS on how to handle the UE clustering case,

* Two companies [Samsung, CMCC] suggest each UE can be randomly assigned UL traffic or DL traffic, which has no dependency with its location (i.e., the probability for UE to be assigned UL traffic or DL traffic has no dependency with whether the UE is located inside or outside the UE cluster).

Qualcomm suggests to remove square bracket for the traffic load (i.e., low (<10%), medium (20%-40%) and high (~50%)).

Moderator suggests **Initial proposal 2-5-1/2-5-2** based on the submitted proposals.

**SBFD Deployment Case 3-2**

For performance evaluation and comparison between baseline legacy TDD network and SBFD Deployment Case 3-2, two companies [Ericsson, CMCC] suggest to reuse the traffic model of Deployment Case 1 as much as possible.

Moderator suggests **Initial proposal 2-5-3** based on the submitted proposals.

**SBFD Deployment Case 4**

For performance evaluation and comparison between baseline legacy TDD network and SBFD Deployment Case 4, three companies [Ericsson, CATT, CMCC] suggest to reuse the traffic model of Deployment Case 1 as much as possible.

DOCOMO suggests common load levels to be used for deployment case 1 and 4.

Nokia suggests DL and UL arrival rates that reach low (<10%), medium (20-30%) and high (~50%) RU can be determined for the single operator legacy TDD case, and those low/medium/high arrival rates can be independently configured for each operator and link direction in the adjacent-channel simulations based on company’s preference.

Ericsson suggests to further consider high input traffic in the aggressor network and low traffic in the victim network.

Intel suggests the following combinations of loads should be considered across operators.

|  |  |  |
| --- | --- | --- |
| **Combination** | **Operator #1 (TDD)** | **Operator #2 (SBFD)** |
| Case #1 | High DL and UL RU | High DL and UL RU |
| Case #2 | High DL and UL RU | Medium DL and UL RU |
| Case #3 | Medium DL and UL RU | High DL and UL RU |
| Case #4 | Medium DL and UL RU | Medium DL and UL RU |

ZTE suggests different load levels in adjacent carriers can be simulated and consider the following as baseline.

* for low load, the adjacent channel interference will be applied with 10% as the probability;
* for medium load, the adjacent channel interference will be applied with 50% as the probability;
* for high load, the adjacent channel interference will be applied with 100% as the probability

Moderator suggests **Initial proposal 2-5-4** based on the submitted proposals.

**Dynamic/flexible TDD**

For performance evaluation and comparison between baseline legacy TDD operation and dynamic/flexible TDD, CMCC suggests to reuse the traffic model in Deployment Case 1 as much as possible.

Moderator suggests **Initial proposal 2-5-5** based on the submitted proposals.

### 1st Round Proposals

#### ***Initial proposal 2-5-1:***

To generate UEs with either UL traffic or DL traffic when UE clustering distribution is applied, each UE is randomly assigned UL traffic or DL traffic, which has no dependency with whether it is located inside or outside the UE cluster.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | Fine |
| Sony | Fine with the proposal. |
| MediaTek | We should have 50% UL-UEs and 50% DL-UEs in each cluster. |
| Ericsson | We support this proposal. |
| QC | We think that half of the UEs (M/2) should be assigned DL traffic and other M/2 assigned UL traffic. |

#### ***Initial proposal 2-5-2:***

Remove square bracket for the traffic load (i.e., low (<10%), medium (20%-40%) and high (~50%)) in previous agreement made in RAN1#110.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | Fine. |
| Sony | Fine with the proposal. |
| Ericsson | We support the proposal with minor modification. For high loads, it does not need to be exactly 50% as mentioned but can be above 50%. ***Initial proposal 2-5-2:*** Remove square bracket for the traffic load (i.e., low (<10%), medium (20%-40%) and high (≥50%)) in previous agreement made in RAN1#110. |
| QC | Support |

#### ***Initial proposal 2-5-3:***

For SBFD deployment case 3-2, reuse the traffic model assumptions of SBFD deployment case 1 as much as possible.

* For comparison between baseline legacy TDD network (i.e., legacy TDD for both Layer 1 and Layer 2) and SBFD deployment case 3-2 (i.e., legacy TDD for Layer 1 and SBFD for Layer 2), the traffic loads are kept the same for each layer.
* The UL traffic load and DL traffic load can be independently selected for each layer. At least consider the assumptions in the following table for UL/DL traffic load combinations, and other combinations are not precluded and can be reported by companies.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Traffic load assumptions for comparison between baseline legacy TDD network and SBFD deployment case 3-2** | | | | |
|  | **Layer 1 (Legacy TDD)** | | **Layer 2 (Legacy TDD or SBFD)** | |
| **DL RU** | **UL RU** | **DL RU** | **UL RU** |
| **Option#1** | low | low | low | medium |
| **Option#2** | low | low | low | high |
| **Option#3** | medium | medium | medium | high |

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We have concern on the second bullet. The table only captures three candidate options, which is too limited. We propose to let companies to report their assumptions. Thus, we propose the following update.   * *The UL traffic load and DL traffic load can be independently selected for each layer~~. At least consider the assumptions in the following table for UL/DL traffic load combinations, and other combinations are not precluded and can be reported by companies.~~*   Alternatively, we can also be ok to copy the table in proposal 2-5-4 here. |
| Huawei, HiSilicon | The traffic model for SBFD deployment case 4 (Option#1 to Option#5) can be reused for deployment case 3-2. |
| Ericsson | We support the proposal. |
| QC | It is better to reduce the number of options to one or two maximums. Is the motivation is to study when L2 (e.g. SBFD deployment) has higher traffic load? |

#### ***Initial proposal 2-5-4:***

For SBFD deployment case 4, reuse the traffic model assumptions of SBFD deployment case 1 as much as possible.

* For comparison between baseline legacy TDD network (i.e., legacy TDD for both Operator#1 and Operator#2) and SBFD deployment case 4 (i.e., legacy TDD for Operator#1 and SBFD for Operator#2), the traffic loads are kept the same for each operator.
* The UL traffic load and DL traffic load can be independently selected for each operator. At least consider the assumptions in the following table for UL/DL traffic load combinations, and other combinations are not precluded and can be reported by companies.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Traffic load assumptions for comparison between baseline legacy TDD network and SBFD deployment case 4** | | | | |
|  | **Operator#1 (Legacy TDD)** | | **Operator#2(Legacy TDD or SBFD)** | |
| **DL RU** | **UL RU** | **DL RU** | **UL RU** |
| **Option#1** | low | low | low | low |
| **Option#2** | medium | medium | medium | medium |
| **Option#3** | high | high | high | high |
| **Option#4** | high | high | low | low |
| **Option#5** | low | low | high | high |

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | generally OK. But we would prefer to let companies to report options they use instead of listing them here in the table. |
| Huawei, HiSilicon | Support. |
| Ericsson | We support the proposal. |
| QC | Similar comments as previous proposals. We need to down select the #options, eg. Three options are sufficient. |

#### ***Initial proposal 2-5-5:***

For dynamic/flexible TDD evaluation, reuse the traffic model assumptions of SBFD evaluation as much as possible.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | Support. |
| Sony | Fine with the proposal. |
| Ericsson | We support the proposal. |
| QC | Support in general, however, we need to highlight the difference w.r.t traffic model agreement for SBFD (If any) |

## Issue#2-6: Antenna configurations

### Submitted proposal

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| CMCC | ***Proposal 25:*** For evaluation of SBFD and dynamic/flexible TDD, companies report the UE antenna configurations used in their simulations. The UE antenna configurations in the following can be considered for calibration purpose.   * FR1:   + 2Tx: (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1), (dH,dV) = (N/A, N/A)λ, 0°,90° polarization   + 4Rx: (M,N,P,Mg,Ng;Mp,Np) = (1,2,2,1,1;1,2), (dH,dV) = (0.5, N/A)λ, 0°,90° polarization * FR2-1:   + 4Tx/Rx: (M,N,P,Mg,Ng;Mp,Np) = (2,4,2,1,2;1,1); (dH,dV) = (0.5,0.5)λ,(dg,V,dg,H) = (0, 0)λ, 0°/90° polarization |
| Ericsson | Observation 8: For real deployments of SBFD network, the TxRUs are more complicated than the TxRUs in static TDD network.  Proposal 21: RAN1 to modify the table for the antenna assumptions for system level simulations as follows.   |  |  |  |  | | --- | --- | --- | --- | | **Scenarios** | **FR** | **Legacy TDD** | **SBFD** | | **BS antenna configuration for Indoor office** | FR1 | = (4,4,2,1,1; 4,4)  = (0.5, 0.5)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (2,4,2,1,1).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.5)λ, +45°/-45° polarization, (da,H,da,V) = (0, 4)λ | | FR2-1 | =(16,8,2,1,1; 1,1)  = (0.5, 0.5)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (8,8,2,1,1).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.5)λ, +45°/-45° polarization, (da,H,da,V) = (0, 30)λ | | **BS antenna configuration for Urban Macro/ Dense Urban Macro layer/ Dense Urban Micro layer** | FR1 | =  (12,8,2,1,1;4,8)  = (0.5, 0.7)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (6,8,2,1,1).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.7)λ, +45°/-45° polarization, (da,H,da,V) = (0, 4)λ | | FR2-1 | =  (8,12,2,2,2; 4,12)  = (0.5, 0.6)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (4,12,2,2,2).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.6)λ, +45°/-45° polarization, (da,H,da,V) = (0, 4)λ | |
| Qualcomm | **Proposal 13: For both options of SBFD BS antenna configurations, at least the transmit panel in SBFD slot should be switchable to Rx mode to enable full DL/UL channel reciprocity.**  **Proposal 14: For FR2 with the total number of 2 TxRUs for legacy TDD in typical FR2 implementation, option 3 is not a reasonable option to make the total number of TxRUs of the antenna array for SBFD to be half of the total number of TxRUs of the antenna array for legacy TDD, in which case only single TxRU and single polarization will be supported. Option 1 and option 2 will be reasonable options.**  **Proposal 15: Adopt the gNB antenna configuration in Table-5 and Table 6.**  **Observation 7: To further optimize the performance of subband full** **duplex when traffic is single direction in SBFD slot, TDD-like single panel configuration could be used to improve the beamforming gain.**  **Proposal 16: At least for FR2, optionally support adaptive antenna array configuration across slots for the subband full duplex evaluation. According to traffic conditions, separate panels configuration shall be used on the subband full duplex slots with scheduled simultaneous downlink and uplink, and TDD-like single panel configuration shall be used on the dynamic TDD slots with scheduled either downlink or uplink.** |
| LG | ***Proposal 3:*** SBFD antenna configuration option and detailed method applied for SBFD evaluation is up to company. |
| Intel | **Proposal 15: For evaluation of SBFD and dynamic/flexible TDD, use the following BS antenna radiation patterns:**   * **InH: reuse Table 10 in Report ITU-R M.2412 for both FR1&FR2-1 (same as Wall-mount model in Table A.2.1-7 in TR 38.802)** * **Urban Macro/ Dense Urban Macro layer / Dense Urban Micro layer: reuse Table 9 in Report ITU-R M.2412 for both FR1&FR2-1 (same as 3-sector BS antenna radiation model in Table A.2.1-6 in TR 38.802)**   **Proposal 16: For evaluation of SBFD and dynamic/flexible TDD, use the following UE antenna radiation patterns:**   * **FR1: Omni-directional with 0 dBi element gain** * **FR2: reuse Table 11 in Report ITU-R M.2412 (same as UE antenna radiation pattern model 1 in Table A.2.1-8 in TR 38.802)** |

### Summary

**SBFD antenna configuration**

In RAN1#110 meeting, three options for SBFD antenna configuration are agreed as following.

|  |
| --- |
| Agreement  For evaluation and comparison between SBFD and legacy TDD, the two options for the SBFD antenna configuration agreed in RAN1#109 are further clarified as below:   * **SBFD antenna configuration option-1** (same as Opt 1 in RAN1#109 agreement): The total number of antenna elements of the antenna array for SBFD is the same as the total number of antenna elements of the antenna array for legacy TDD. The total number of TxRUs of the antenna array for SBFD is the same as the total number of TxRUs of the antenna array for legacy TDD. * **SBFD antenna configuration option-2** (same as Opt 2 in RAN1#109 agreement): The total number of antenna elements of the antenna array for SBFD is two times of the total number of antenna elements of the antenna array for legacy TDD. The total number of TxRUs of the antenna array for SBFD is the same as the total number of TxRUs of the antenna array for legacy TDD. * **SBFD antenna configuration option-3** (new): The total number of antenna elements of the antenna array for SBFD is the same as the total number of antenna elements of the antenna array for legacy TDD. The total number of TxRUs of the antenna array for SBFD is half of the total number of TxRUs of the antenna array for legacy TDD. |

Qualcomm suggests Option 1 and Option 2 of SBFD BS antenna configurations as reasonable options, and for the both options, at least the transmit panel in SBFD slot should be switchable to Rx mode to enable full DL/UL channel reciprocity.

Qualcomm suggests to optionally support adaptive antenna array configuration across slots for the subband full duplex evaluation at least for FR2.

LG suggests that SBFD antenna configuration option and detailed method applied for SBFD evaluation is up to company.

**BS antenna configurations**

In RAN1#110 meeting, agreement was achieved on BS antenna configurations.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agreement**  For evaluation of SBFD operation, it is up to companies to report the BS antenna configurations used in their simulations. The BS antenna configurations in the following table can be considered for calibration purpose.   |  |  |  |  | | --- | --- | --- | --- | | **Scenarios** | **FR** | **Legacy TDD** | **SBFD** | | **BS antenna configuration for Indoor office** | FR1 | = (4,4,2,1,1; 4,4)  = (0.5, 0.5)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (2,4,2,1,1).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.5)λ, +45°/-45° polarization, (da,H,da,V) = (0, 4)λ | | FR2-1 | =(16,8,2,1,1; 1,1)  = (0.5, 0.5)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (8,8,2,1,1).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.5)λ, +45°/-45° polarization, (da,H,da,V) = (0, 30)λ | | **BS antenna configuration for Urban Macro/ Dense Urban Macro layer/ Dense Urban Micro layer** | FR1 | =  (8,8,2,1,1;2,8)  = (0.5, 0.8)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (4,8,2,1,1).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.8)λ, +45°/-45° polarization, (da,H,da,V) = (0, 4)λ | | FR2-1 | =  (4,16,2,2,2; 1,1)  = (0.5, 0.5)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (4,8,2,2,2).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.5)λ, +45°/-45° polarization, (da,H,da,V) = (0, 30)λ | |

Ericsson suggests to modify the BS antenna assumptions BS antenna configuration for Urban Macro/ Dense Urban Macro layer/ Dense Urban Micro layer in the above table.

* FR1: =(12,8,2,1,1;4,8), = (0.5, 0.7)λ, +45°/-45° polarization.
* FR2: =(8,12,2,2,2; 4,12), = (0.5, 0.6)λ, +45°/-45° polarization

Moderator suggests **Initial question 2-6-1**.

**UE antenna configurations**

CMCC suggests for evaluation of SBFD and dynamic/flexible TDD, companies report the UE antenna configurations used in their simulations. The UE antenna configurations in the following can be considered for calibration purpose.

* FR1:
  + 2Tx: (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1), (dH,dV) = (N/A, N/A)λ, 0°,90° polarization
  + 4Rx: (M,N,P,Mg,Ng;Mp,Np) = (1,2,2,1,1;1,2), (dH,dV) = (0.5, N/A)λ, 0°,90° polarization
* FR2-1:
  + 4Tx/Rx: (M,N,P,Mg,Ng;Mp,Np) = (2,4,2,1,2;1,1); (dH,dV) = (0.5,0.5)λ,(dg,V,dg,H) = (0, 0)λ, 0°/90° polarization

Moderator suggests **Initial proposal 2-6-2** based on the submitted proposals.

### 1st Round Proposals

#### ***Initial question 2-6-1:***

Whether to modify the BS antenna configurations for calibration purpose agreed in RAN1#110 as follows?

|  |  |  |  |
| --- | --- | --- | --- |
| **Scenarios** | **FR** | **Legacy TDD** | **SBFD** |
| **BS antenna configuration for Indoor office** | FR1 | = (4,4,2,1,1; 4,4)  = (0.5, 0.5)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (2,4,2,1,1).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.5)λ, +45°/-45° polarization, (da,H,da,V) = (0, 4)λ |
| FR2-1 | =(16,8,2,1,1; 1,1)  = (0.5, 0.5)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (8,8,2,1,1).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.5)λ, +45°/-45° polarization, (da,H,da,V) = (0, 30)λ |
| **BS antenna configuration for Urban Macro/ Dense Urban Macro layer/ Dense Urban Micro layer** | FR1 | =  (12,8,2,1,1;4,8)  = (0.5, 0.7)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (6,8,2,1,1).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.7)λ, +45°/-45° polarization, (da,H,da,V) = (0, 4)λ |
| FR2-1 | =  (8,12,2,2,2; 4,12)  = (0.5, 0.6)λ, +45°/-45° polarization | * SBFD antenna configuration option-1 (Method 1)   + Two panel groups   + For each panel group: = (4,12,2,2,2).   + Number of TxRUs: same as legacy TDD   + = (0.5, 0.6)λ, +45°/-45° polarization, (da,H,da,V) = (0, 4)λ |

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We prefer to stick with the previous agreements. Do we have any strong motivation to update the antenna configurations? |
| Huawei, HiSilicon | We can live with either of them. The BS antenna configurations for calibration purpose agreed in RAN1#110 is preferred slightly. |
| Sony | No need to modify the previous agreement, i.e. stick to the previous agreement. Generally not good to change an agreement unless there is a strong motivation. |
| Ericsson | We support the proposal. As mentioned in our contribution, these values were sent to ITU-R in an LS from RAN4 reflecting realistic BS antenna configurations.   Please note that the initial agreement had the following statement which needs to be added here as well.  *“For evaluation of SBFD operation, it is up to companies to report the BS antenna configurations used in their simulations. The BS antenna configurations in the following table can be considered for calibration purpose.”* |
| New H3C | We slightly prefer keeping agreement in in RAN1#110 |
| QC | Support to stick to previous agreement on antenna configuration. Is there a strong motivation of change? For FR2, why should we use that large Mp, Np? That will be more applicable for FR1. |

#### ***Initial proposal 2-6-2:***

For evaluation of SBFD and dynamic/flexible TDD, companies report the UE antenna configurations used in their simulations. The UE antenna configurations in the following can be considered for calibration purpose.

* FR1:
  + 2Tx: (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1), (dH,dV) = (N/A, N/A)λ, 0°,90° polarization
  + 4Rx: (M,N,P,Mg,Ng;Mp,Np) = (1,2,2,1,1;1,2), (dH,dV) = (0.5, N/A)λ, 0°,90° polarization
* FR2-1:
  + 4Tx/Rx: (M,N,P,Mg,Ng;Mp,Np) = (2,4,2,1,2;1,1); (dH,dV) = (0.5,0.5)λ,(dg,V,dg,H) = (0, 0)λ, 0°/90° polarization

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | To simplify the simulation and reduce the simulation time, 2Tx/Rx with (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) is preferred for FR1. We can also live with 4Tx/Rx with (M,N,P,Mg,Ng;Mp,Np) = (2,4,2,1,2;1,1) for FR1. |
| New H3C | OK |
| QC | Support 2T4R configuration for FR1.  Clarify whether configuration of FR2-1 with 2 UE panels. We support 2 panels for UE by reusing below based on 38.802:  In case of multiple panels:  (M, N, P, Mg, Ng) = (2, 4, 2, 1, 2); (dV, dH) = (0.5, 0.5)λ. (dg,V, dg,H) = (0, 0)λ.  Θmg,ng=90°; Ω0,1=Ω0,0+180°;  Notes: the polarization angles are 0° and 90°  Notes: introduce (Ωmg,ng, Θmg,ng) for orientation of the panel (mg, ng), 0≤mg<Mg, 0≤ng<Ng, where the orientation of the first panel (Ω0,0, Θ0,0) is the same as UE orientation, Ωmg,ng is the array bearing angle and Θmg,ng is the array downtilt angle defined in [TR 36.873]. |

## Issue#2-7: Channel model and penetration loss

### Submitted proposal

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| **Company** | **Proposals** |
| CMCC | ***Proposal 26:*** Confirm the following working assumption for gNB-gNB channel model and gNB-UE channel model.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Working assumption:**  Adopt the following table for gNB-gNB channel model and gNB-UE channel model.   |  |  |  | | --- | --- | --- | |  | **Dense urban, Urban macro** | **Indoor office** | | Large-scale channel parameters | FR1:   * Macro-to-UE: UMa in TR 38.901 * Micro-to-UE: UMi-Street canyon in TR 38.901 * Macro-to-Macro: UMa in TR 38.901 (hUE =25m), * Macro-to-Micro: UMa in TR 38.901 (hUE =10m) * Micro-to-Micro: UMi-Street canyon in TR 38.901 (hUE =10m)   FR2-1:   * Macro-to-UE: UMa in TR 38.901 * Micro-to-UE: UMi-Street canyon in TR 38.901 * Macro-to-Macro: UMa in TR 38.901 (hUE =25m) * Macro-to-Micro: UMa in TR 38.901 (hUE =10m) * Micro-to-Micro: UMi-Street canyon in TR 38.901 (hUE =10m) | FR1:   * TRP-to-UE: InH-Office in TR 38.901 * TRP-to-TRP: InH-Office in TR 38.901 (hUE =3m)   FR2-1:   * TRP-to-UE: InH-Office in TR 38.901 * TRP-to-TRP: InH-Office in TR 38.901 (hUE =3m) | | Fast fading parameters | FR1:   * Macro-to-UE: UMa in TR 38.901 * Micro-to-UE: UMi-Street canyon in TR 38.901 * Macro-to-Macro: UMa O2O in TR 38.901 (hUE =25m); ASA and ZSA statistics updated to be the same as ASD and ZSD; ZoD offset = 0 * Macro-to-Micro: UMa O2O in TR 38.901 * Micro-to-Micro: UMi-Street canyon O2O in TR 38.901 (hUE=10m); ASA and ZSA statistics updated to be the same as ASD and ZSD; ZoD offset = 0   FR2-1:   * Macro-to-UE: UMa in TR 38.901 * Micro-to-UE: UMi-Street canyon in TR 38.901 * Macro-to-Macro: UMa O2O in TR 38.901 (hUE=25m); ASA and ZSA statistics updated to be the same as ASD and ZSD; ZoD offset = 0 * Macro-to-Micro: UMa O2O in TR 38.901 * Micro-to-Micro: UMi-Street canyon O2O in TR 38.901 (hUE=10m); ASA and ZSA statistics updated to be the same as ASD and ZSD; ZoD offset = 0 | FR1:   * TRP-to-UE: InH-Office in TR 38.901 * TRP-to-TRP: InH-Office in TR 38.901 (hUE=3m), ASA and ZSA statistics updated to be the same as ASD and ZSD   FR2-1:   * TRP-to-UE: InH-Office in TR 38.901 * TRP-to-TRP: InH-Office in TR 38.901 (hUE =3m), ASA and ZSA statistics updated to be the same as ASD and ZSD | |   ***Proposal 27:*** Confirm the following working assumption for UE-UE channel model.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Working Assumption  For UE-UE channel model, reuse the UE-UE channel model for flexible duplex evaluation in TR 38.802 for both FR1 and FR2 as baseline, and other models are not precluded.  UE-UE channel model   |  |  |  | | --- | --- | --- | |  | **Dense urban, Urban macro** | **Indoor hotspot** | | Large-scale channel parameters | FR1:   * Option 1: UE-to-UE: A.2.1.2 in TR36.843(\*), penetration loss between UEs follows Table A.2.1-13 in TR38.802 * Option 2: UE-to-UE: UMi-Street canyon in TR 38.901 (hBS =1.5m ~ 22.5m), penetration loss between UEs follows Table A.2.1-13 in TR38.802   FR2-1:   * UE-to-UE: UMi-Street canyon in TR 38.901 (hBS =1.5m ~ 22.5m), penetration loss between UEs follows Table A.2.1-12 in TR38.802 | FR1:   * Option1 : UE-to-UE: A.2.1.2 in TR36.843 (\*) * Option 2: UE-to-UE: InH-Office in TR 38.901 (hBS =1.5m)   FR2-1:   * UE-to-UE: InH-Office in TR 38.901 (hBS =1.5m) | | Fast fading parameters | FR1:   * Option 1: UE-to-UE: A.2.1.2 in TR36.843 (ITU InH) for indoor to indoor, and 3D UMi for other cases. ASD and ZSD statistics updated to be the same as ASA and ZSA. * Optioin 2: UE-to-UE: UMi-Street canyon in TR 38.901; ASD and ZSD statistics updated to be the same as ASA and ZSA.   FR2-1:   * UE-to-UE: UMi-Street canyon in TR 38.901; ASD and ZSD statistics updated to be the same as ASA and ZSA. | FR1:   * Option 1: UE-to-UE: A.2.1.2 in TR36.843 (ITU InH), ASD statistics updated to be the same as ASA. * Option2: UE-to-UE: InH-Office in TR 38.901 (hBS =1.5m), ASD and ZSD statistics updated to be the same as ASA and ZSA   FR2-1:   * UE-to-UE: InH-Office in TR 38.901 (hBS =1.5m), ASD and ZSD statistics updated to be the same as ASA and ZSA | | (\*): For outdoor to indoor case, and indoor to indoor case, use “Remaining Layout Options” in A.2.1.2 of TR36.843 for pathloss calculation, and “ITU-R IMT UMi” for LOS Probability derivation. For outdoor to indoor case, the penetration loss term “20.0+0.5\* din” is excluded in pathloss formula given in A.2.1.2 of TR36.843, and the penetration loss is derived according to Table A.2.1-13 in TR38.802. | | | |   ***Proposal 28:*** Adopt the following gNB-UE O2I building penetration loss model:   * Indoor office: penetration loss is not modelled. * Percentage of high loss and low loss building type for Urban Macro / Dense Urban [refer to table 5B of ITU M.2412]:   + 80% low-loss model   + 20% high-loss model   + Note: The building type is determined by comparing the random variable with P1, where P1 is the probability of the building type with low loss penetration. If the realization of the random variable is less than P1, the building type is low loss; otherwise the building type is high loss [refer to section 5.3.3 of ITU M.2412].   ***Proposal 29:*** Adopt the following table for gNB-UE channel model for 2-layer Scenario B (HetNet with Urban Macro and Indoor).   |  |  | | --- | --- | |  | **gNB-UE channel model for 2-layer Scenario B** | | Large-scale channel parameters | FR1:   * Macro TRP to Outdoor UE: UMa in TR 38.901   + Car penetration loss in TR 38.901 is modelled * Indoor TRP to Indoor UE:   + For Indoor office layer: InH-Office in TR 38.901   + For Indoor factory layer: InF in TR 38.901   + Penetration loss is not modelled. * Macro TRP to Indoor UE:   + UMa in TR 38.901   + O2I penetration loss follows TR 38.901 except that is the real 2D distance between indoor UE and the building wall.     - For the percentage of high loss and low loss building type, 80% low-loss model and 20% high-loss model is considered. * Indoor TRP to Outdoor UE:   + For Indoor office layer: InH-Office in TR 38.901 [TR 38.828 Table 5.2.1.1.2-1]   + For Indoor factory layer: InF in TR 38.901   + Both Car penetration (for outdoor UE) and O2I penetration loss are modelled, wherein, O2I penetration loss follows TR 38.901 except that is the real 2D distance between indoor TRP and the building wall.     - For the percentage of high loss and low loss building type, 80% low-loss model and 20% high-loss model is considered. | | Fast fading parameters | FR1:   * Macro TRP to Outdoor UE: UMa in TR 38.901 * Indoor TRP to Indoor UE:   + For Indoor office layer: InH-Office in TR 38.901   + For Indoor factory layer: InF in TR 38.901 * Macro TRP to Indoor UE: UMa in TR 38.901 * Indoor TRP to Outdoor UE:   + For Indoor office layer: InH-Office in TR 38.901 [TR 38.828 Table 5.2.1.1.2-1]   + For Indoor factory layer: InF in TR 38.901 |   ***Proposal 30:*** Adopt the following table for gNB-gNB channel model for 2-layer Scenario B (HetNet with Urban Macro and Indoor).   |  |  | | --- | --- | |  | **gNB-gNB channel model for 2-layer Scenario B** | | Large-scale channel parameters | FR1:   * Macro TRP to Macro TRP: not needed. * Indoor TRP to Indoor TRP: Only the channel model between Indoor TRPs within the same building is considered   + For Indoor office layer: InH-Office in TR 38.901 (hUE =3m).   + For Indoor factory layer: InF in TR 38.901 (hUE =3m).   + Penetration loss is not modelled. * Macro TRP to Indoor TRP:   + UMa in TR 38.901 (hUE =3m)   + O2I penetration loss follows TR 38.901 except that is the real 2D distance between indoor TRP and the building wall.     - For the percentage of high loss and low loss building type, 80% low-loss model and 20% high-loss model is considered. | | Fast fading parameters | FR1:   * Macro TRP to Macro TRP: not needed. * Indoor TRP to Indoor TRP: Only the channel model between Indoor TRPs within the same building is considered.   + For Indoor office layer: InH-Office in TR 38.901 (hUE =3m). ASA and ZSA statistics updated to be the same as ASD and ZSD.   + For Indoor factory layer: InF in TR 38.901 (hUE =3m). ASA and ZSA statistics updated to be the same as ASD and ZSD * Macro TRP to Indoor TRP:   + UMa in TR 38.901 (hUE =3m) |   ***Proposal 31:*** Adopt the following table for UE-UE channel model for 2-layer Scenario B (HetNet with Urban Macro and Indoor).   |  |  | | --- | --- | |  | **UE-UE channel model for 2-layer Scenario B** | | Large-scale channel parameters | FR1:   * Outdoor UE to Outdoor UE:   + Option 1: A.2.1.2 in TR36.843 (\*)   + Option 2: UMi-Street canyon in TR 38.901 (hBS =1.5m)   + Penetration loss between UEs follows Table A.2.1-13 in TR38.802 * Indoor UE to Indoor UE: Only the channel model between Indoor UEs within the same building is considered   + Option 1: A.2.1.2 in TR36.843 (\*).   + Option 2:     - For Indoor office layer: InH-Office in TR 38.901 (hBS =1.5m).     - For Indoor factory layer: InF in TR 38.901 (hBS =1.5m).   + Penetration loss is not modelled. * Outdoor UE to Indoor UE:   + Option 1: A.2.1.2 in TR36.843 (\*).   + Option 2: UMi-Street canyon in TR 38.901 (hBS =1.5m).   + Penetration loss between UEs follows Table A.2.1-13 in TR38.802 except for that as the real 2D distance between indoor UE and the building wall. | | Fast fading parameters | FR1:   * Outdoor UE to Outdoor UE:   + Option 1: 3D UMi, ASD and ZSD statistics updated to be the same as ASA and ZSA.   + Option 2: UMi-Street canyon in TR 38.901 (hBS =1.5m), ASD and ZSD statistics updated to be the same as ASA and ZSA. * Indoor UE to Indoor UE: Only the channel model between Indoor UEs within the same building is considered   + Option 1: A.2.1.2 in TR36.843 (ITU InH), ASD statistics updated to be the same as ASA.   + Option 2:     - For Indoor office layer: InH-Office in TR 38.901 (hBS =1.5m). ASD and ZSD statistics updated to be the same as ASA and ZSA.     - For Indoor factory layer: InF in TR 38.901 (hBS =1.5m). ASD and ZSD statistics updated to be the same as ASA and ZSA. * Outdoor UE to Indoor UE:   + Option 1: 3D UMi, ASD and ZSD statistics updated to be the same as ASA and ZSA.   + Option 2: UMi-Street canyon in TR 38.901 (hBS =1.5m). ASD and ZSD statistics updated to be the same as ASA and ZSA. | |
| Huawei | ***Proposal 16:*** *Confirm the Working Assumption in RAN1#110 about gNB-gNB channel model and gNB-UE channel model under UMa, Dense Urban, and InH scenarios.*  ***Proposal 17:*** *Adopt the gNB-gNB channel model and gNB-UE channel model under HetNet scenario for Deployment Case 3-2 in Table A.2-1.*   * *The channel models of Macro-to-UE, Macro-to-Macro, TRP-to-UE, and TRP-to-TRP links in the Working Assumptions in RAN1#110 about gNB-gNB channel model and gNB-UE channel model under UMa, Dense Urban, and InH scenarios can be reused for that under HetNet scenario.* * *The channel model of Macro-to-TRP link under HetNet scenario can be modeled as UMa O2I channel model in TR 38.901, where the UE is replaced as TRP, i.e., hUE = 3m.*   ***Proposal 18:*** *Adopt the gNB-gNB penetration loss models and gNB-UE penetration loss models under UMa, Dense Urban, InH, and HetNet scenarios in Table A.2-2.*  ***Proposal 19:*** *Confirm the Working Assumption in RAN1#110 about UE-UE channel model under UMa, Dense Urban, and InH scenarios.*  ***Proposal 20:*** *Adopt the UE-UE channel model under HetNet scenario in Table A.2-3.* |
| ZTE | ***Proposal 8****: Regarding the channel model for dense urban with two layers, define the following channel model.*   * *Micro-to-Macro: UMi-Street canyon in TR 38.901 (hUE =25m)* |
| Samsung | *Proposal 7: For UE-UE channel model in FR1, RAN1 to take the channel model in TR38.901, i.e., Option 2. For details,*   * *For Dense urban and Urban macro and for Large-scale channel parameters,*    + *Option 2: UE-to-UE: UMi-Street canyon in TR 38.901 (hBS =1.5m ~ 22.5m), penetration loss between UEs follows Table A.2.1-13 in TR38.802* * *For Indoor hopspot and for Large-scale channel parameters,*    + *Option 2: UE-to-UE: InH-Office in TR 38.901 (hBS =1.5m)* * *For Dense urban and Urban macro and for fast fading parameters,*    + *Option 2: UE-to-UE: UMi-Street canyon in TR 38.901; ASD and ZSD statistics updated to be the same as ASA and ZSA.* * *For Indoor hopspot and for fast fading parameters,*   + *Option2: UE-to-UE: InH-Office in TR 38.901 (hBS =1.5m), ASD and ZSD statistics updated to be the same as ASA and ZSA* |
| Qualcomm | **Proposal 20**: **Confirm the working assumption on the gNB-gNB and gNB-UE channel modelling.**  **Observation 10: LOS probability will have large impact on the inter-gNB CLI and any candidate solutions.**  **Observation 11: Inter-UE pathloss computation based on leveraging gNB-UE model in 38.901 is not accurate.**   * **The pathloss equations in 38.901 are based on certain applicability range of base station height which not suitable for UE.** * **The UMa/UMi PL models consider a minimum distance between gNB and UE as 35/10m which is not valid as inter-UE distance could be small as <1m.**   **Proposal 21: RAN1 to clarify when UE clustering is used, whether all indoor UEs are considered inside the building.**  **Proposal 22: RAN1 to clarify whether/how to model car penetration loss.** |
| LG | ***Proposal 2:*** Confirm the working assumptions on gNB-gNB/gNB-UE channel model and UE-UE channel model. |
| Xiaomi | **Proposal 7: Confirm the two working assumptions related to gNB-to-gNB channel model and UE-to-UE channel model achieved in RAN1#110 meeting.** |
| Spreadtrum | ***Proposal 13: Large scale fading and small scale fading should be taken into consider for gNB-gNB channel model and only large scale fading should be considered in UE-UE channel model in SLS calibration.*** |
| Intel | **Proposal 4:**   * **The working assumption made during RAN1 #110 related to gNB-gNB channel model and gNB-UE channel model is confirmed.**   **Proposal 5:**   * **Reuse the gNB-UE 5GCM in TR 38.901 with necessary modifications for both FR1 and FR2, similar as the UE-UE channel model for flexible duplex evaluation in TR38.802 for FR2.**   + **For Indoor hotspot, reuse the gNB-UE 5GCM Indoor-office in TR38.901, and for Dense urban and Urban macro, reuse the gNB-UE 5GCM Umi-Street canyon in TR38.901 with necessary modification, e.g.,**      - **Replacing the gNB’s antenna height with UE’s antenna height, updating ASD and ZSD.**     - **FFS: Other details and necessary modifications.** |
| KT | ***Proposal 1: Confirm current Working assumption on parameters for gNB-gNB and gNB-UE channel model***  ***Proposal 3: Confirm current Working assumption on parameters for UE-UE channel model*** |

### Summary

In RAN1#110 meeting, Working Assumption was made for gNB-gNB channel model and gNB-UE channel model under UMa, Dense Urban, and InH scenarios.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Working assumption:**  Adopt the following table for gNB-gNB channel model and gNB-UE channel model.   |  |  |  | | --- | --- | --- | |  | **Dense urban, Urban macro** | **Indoor office** | | Large-scale channel parameters | FR1:   * Macro-to-UE: UMa in TR 38.901 * Micro-to-UE: UMi-Street canyon in TR 38.901 * Macro-to-Macro: UMa in TR 38.901 (hUE =25m), * Macro-to-Micro: UMa in TR 38.901 (hUE =10m) * Micro-to-Micro: UMi-Street canyon in TR 38.901 (hUE =10m)   FR2-1:   * Macro-to-UE: UMa in TR 38.901 * Micro-to-UE: UMi-Street canyon in TR 38.901 * Macro-to-Macro: UMa in TR 38.901 (hUE =25m) * Macro-to-Micro: UMa in TR 38.901 (hUE =10m) * Micro-to-Micro: UMi-Street canyon in TR 38.901 (hUE =10m) | FR1:   * TRP-to-UE: InH-Office in TR 38.901 * TRP-to-TRP: InH-Office in TR 38.901 (hUE =3m)   FR2-1:   * TRP-to-UE: InH-Office in TR 38.901 * TRP-to-TRP: InH-Office in TR 38.901 (hUE =3m) | | Fast fading parameters | FR1:   * Macro-to-UE: UMa in TR 38.901 * Micro-to-UE: UMi-Street canyon in TR 38.901 * Macro-to-Macro: UMa O2O in TR 38.901 (hUE =25m); ASA and ZSA statistics updated to be the same as ASD and ZSD; ZoD offset = 0 * Macro-to-Micro: UMa O2O in TR 38.901 * Micro-to-Micro: UMi-Street canyon O2O in TR 38.901 (hUE=10m); ASA and ZSA statistics updated to be the same as ASD and ZSD; ZoD offset = 0   FR2-1:   * Macro-to-UE: UMa in TR 38.901 * Micro-to-UE: UMi-Street canyon in TR 38.901 * Macro-to-Macro: UMa O2O in TR 38.901 (hUE=25m); ASA and ZSA statistics updated to be the same as ASD and ZSD; ZoD offset = 0 * Macro-to-Micro: UMa O2O in TR 38.901 * Micro-to-Micro: UMi-Street canyon O2O in TR 38.901 (hUE=10m); ASA and ZSA statistics updated to be the same as ASD and ZSD; ZoD offset = 0 | FR1:   * TRP-to-UE: InH-Office in TR 38.901 * TRP-to-TRP: InH-Office in TR 38.901 (hUE=3m), ASA and ZSA statistics updated to be the same as ASD and ZSD   FR2-1:   * TRP-to-UE: InH-Office in TR 38.901 * TRP-to-TRP: InH-Office in TR 38.901 (hUE =3m), ASA and ZSA statistics updated to be the same as ASD and ZSD | |

Seven companies [Huawei, Qualcomm, LG, Xiaomi, Intel, KT, CMCC] suggest to confirm the above Working Assumption for gNB-gNB channel model and gNB-UE channel model under UMa, Dense Urban, and InH scenarios.

ZTE suggests to define the following channel model for the channel model for dense urban with two layers.

* Micro-to-Macro: UMi-Street canyon in TR 38.901 (hUE =25m)

Moderator thinks there is no need to specifically define Micro-to-Macro channel model, it should be the same as Macro-to-Micro channel model.

Moderator suggests **Initial proposal 2-7-1** based on the submitted proposals.

In RAN1#110 meeting, Working Assumption was made for UE-UE channel model under UMa, Dense Urban, and InH scenarios.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Working Assumption  For UE-UE channel model, reuse the UE-UE channel model for flexible duplex evaluation in TR 38.802 for both FR1 and FR2 as baseline, and other models are not precluded.   |  |  |  | | --- | --- | --- | |  | **Dense urban, Urban macro** | **Indoor hotspot** | | Large-scale channel parameters | FR1:   * Option 1: UE-to-UE: A.2.1.2 in TR36.843(\*), penetration loss between UEs follows Table A.2.1-13 in TR38.802 * Option 2: UE-to-UE: UMi-Street canyon in TR 38.901 (hBS =1.5m ~ 22.5m), penetration loss between UEs follows Table A.2.1-13 in TR38.802   FR2-1:   * UE-to-UE: UMi-Street canyon in TR 38.901 (hBS =1.5m ~ 22.5m), penetration loss between UEs follows Table A.2.1-12 in TR38.802 | FR1:   * Option1 : UE-to-UE: A.2.1.2 in TR36.843 (\*) * Option 2: UE-to-UE: InH-Office in TR 38.901 (hBS =1.5m)   FR2-1:   * UE-to-UE: InH-Office in TR 38.901 (hBS =1.5m) | | Fast fading parameters | FR1:   * Option 1: UE-to-UE: A.2.1.2 in TR36.843 (ITU InH) for indoor to indoor, and 3D UMi for other cases. ASD and ZSD statistics updated to be the same as ASA and ZSA. * Option 2: UE-to-UE: UMi-Street canyon in TR 38.901; ASD and ZSD statistics updated to be the same as ASA and ZSA.   FR2-1:   * UE-to-UE: UMi-Street canyon in TR 38.901; ASD and ZSD statistics updated to be the same as ASA and ZSA. | FR1:   * Option 1: UE-to-UE: A.2.1.2 in TR36.843 (ITU InH), ASD statistics updated to be the same as ASA. * Option2: UE-to-UE: InH-Office in TR 38.901 (hBS =1.5m), ASD and ZSD statistics updated to be the same as ASA and ZSA   FR2-1:   * UE-to-UE: InH-Office in TR 38.901 (hBS =1.5m), ASD and ZSD statistics updated to be the same as ASA and ZSA | | (\*): For outdoor to indoor case, and indoor to indoor case, use “Remaining Layout Options” in A.2.1.2 of TR36.843 for pathloss calculation, and “ITU-R IMT UMi” for LOS Probability derivation. For outdoor to indoor case, the penetration loss term “20.0+0.5\* din” is excluded in pathloss formula given in A.2.1.2 of TR36.843, and the penetration loss is derived according to Table A.2.1-13 in TR38.802. | | | |

Six companies [Huawei, LG, Xiaomi, Intel, KT, CMCC] suggest to confirm the above Working Assumption for UE-UE channel model under UMa, Dense Urban, and InH scenarios.

Two companies [Samsung, Intel] still prefer to adopt Option 2 (i.e., the channel model in TR38.901) for UE-UE channel model in FR1.

Moderator suggests **Initial proposal 2-7-2** based on the submitted proposals.

CMCC suggests to adopt the following gNB-UE O2I building penetration loss model:

* Indoor office: penetration loss is not modelled.
* Percentage of high loss and low loss building type for Urban Macro / Dense Urban [refer to table 5B of ITU M.2412]:
  + 80% low-loss model
  + 20% high-loss model
  + Note: The building type is determined by comparing the random variable with P1, where P1 is the probability of the building type with low loss penetration. If the realization of the random variable is less than P1, the building type is low loss; otherwise the building type is high loss [refer to section 5.3.3 of ITU M.2412].

Moderator suggests **Initial proposal 2-7-3** based on the submitted proposals.

For channel model of 2-layer Scenario B (HetNet with Urban Macro and Indoor), CMCC suggests to adopt the channel model as follows:

* Regarding the gNB-UE channel model for 2-layer Scenario B (HetNet with Urban Macro and Indoor),
  + Macro TRP to Outdoor UE:
    - UMa in TR 38.901
    - Car penetration loss in TR 38.901 is modelled, i.e., , *μ* = 9, and σ*P* = 5.
  + Indoor TRP to Indoor UE:
    - For Indoor office layer: InH-Office in TR 38.901
    - For Indoor factory layer: InF in TR 38.901
    - Penetration loss is not modelled.
  + Macro TRP to Indoor UE:
    - UMa in TR 38.901
    - O2I penetration loss follows TR 38.901 except that is the real 2D distance between indoor UE and the building wall.
      * For the percentage of high loss and low loss building type, 80% low-loss model and 20% high-loss model is considered.
  + Indoor TRP to Outdoor UE:
    - For Indoor office layer: InH-Office in TR 38.901 [TR 38.828 Table 5.2.1.1.2-1]
    - For Indoor factory layer: InF in TR 38.901
    - Both Car penetration (for outdoor UE) and O2I penetration loss are modelled, wherein, O2I penetration loss follows TR 38.901 except that is the real 2D distance between indoor TRP and the building wall.
      * For the percentage of high loss and low loss building type, 80% low-loss model and 20% high-loss model is considered.
* Regarding the gNB-gNB channel model for 2-layer Scenario B (HetNet with Urban Macro and Indoor),
  + Macro TRP to Macro TRP: not needed, since Macro layer uses legacy static TDD operation with the same TDD UL/DL configuration.
  + Indoor TRP to Indoor TRP:
    - Only the channel model between Indoor TRPs within the same building is considered, and the channel between Indoor TRPs from different buildings is not modelled.
    - For Indoor office layer: InH-Office in TR 38.901 (hUE =3m). ASA and ZSA statistics updated to be the same as ASD and ZSD.
    - For Indoor factory layer: InF in TR 38.901 (hUE =3m). ASA and ZSA statistics updated to be the same as ASD and ZSD
    - Penetration loss is not modelled.
  + Macro TRP to Indoor TRP:
    - UMa in TR 38.901 (hUE =3m)
    - O2I penetration loss follows TR 38.901 except that is the real 2D distance between indoor TRP and the building wall.
      * For the percentage of high loss and low loss building type, 80% low-loss model and 20% high-loss model is considered.
  + Indoor TRP to Macro TRP:
    - UMa in TR 38.901 (hUE =25m)
    - O2I penetration loss follows TR 38.901 except that is the real 2D distance between indoor TRP and the building wall.
      * For the percentage of high loss and low loss building type, 80% low-loss model and 20% high-loss model is considered.
* Regarding the UE-UE channel model for 2-layer Scenario B (HetNet with Urban Macro and Indoor),
  + Outdoor UE to Outdoor UE:
    - Option 1: A.2.1.2 in TR36.843 (\*). For fast fading parameters, 3D UMi is used with ASD and ZSD statistics updated to be the same as ASA and ZSA.
    - Option 2: UMi-Street canyon in TR 38.901 (hBS =1.5m). ASD and ZSD statistics updated to be the same as ASA and ZSA.
    - Penetration loss between UEs follows Table A.2.1-13 in TR38.802
  + Indoor UE to Indoor UE: Only the channel model between Indoor UEs within the same building is considered, and the channel between Indoor UEs from different buildings is not modelled.
    - Option 1: A.2.1.2 in TR36.843 (\*). ASD statistics updated to be the same as ASA.
    - Option 2:
      * For Indoor office layer: InH-Office in TR 38.901 (hBS =1.5m). ASD and ZSD statistics updated to be the same as ASA and ZSA.
      * For Indoor factory layer: InF in TR 38.901 (hBS =1.5m). ASD and ZSD statistics updated to be the same as ASA and ZSA.
    - Penetration loss is not modelled.
  + Outdoor UE to Indoor UE:
    - Option 1: A.2.1.2 in TR36.843 (\*). ASD statistics updated to be the same as ASA.
    - Option 2: UMi-Street canyon in TR 38.901 (hBS =1.5m). ASD and ZSD statistics updated to be the same as ASA and ZSA.
    - Penetration loss between UEs follows Table A.2.1-13 in TR38.802 except for that as the real 2D distance between indoor UE and the building wall.
* Note that as shown below, can be calculated as follows

wherein,

* + is the total 2-D distance between indoor UE and BS;
  + is the 2-D distance between indoor UE and the building wall;
  + is the 2-D distance between BS and the building wall.

 

Moderator suggests **Initial proposal 2-7-4, 2-7-5 and 2-7-6** based on the submitted proposals.

**Others**

Qualcomm raises that RAN1 to clarify when UE clustering is used, whether all indoor UEs are considered inside the same building. Furthermore, it is observed that in 38.901, car penetration loss is modelled as where = 9, σ*P*=5, and for metallized car windows = 20 can be used. Thus, Qualcomm raises that RAN1 to clarify how to model car penetration loss.

Moderator suggests **Initial proposal 2-7-7 and 2-7-8** based on the submitted proposals.

### 1st Round Proposals

#### ***Initial proposal 2-7-1:***

Confirm the working assumption for gNB-gNB channel model and gNB-UE channel model made in RAN1#110.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | OK. |
| Sony | Support. |
| Ericsson | Support |
| New H3C | OK |
| QC | Support |

#### ***Initial proposal 2-7-2:***

Confirm the working assumption for UE-UE channel model made in RAN1#110.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | Support. |
| Sony | Support. |
| Ericsson | Support |
| New H3C | OK |
| QC | Support |

#### ***Initial proposal 2-7-3:***

Adopt the following gNB-UE O2I building penetration loss model:

* Indoor office: penetration loss is not modelled.
* Percentage of high loss and low loss building type for Urban Macro / Dense Urban [refer to table 5B of ITU M.2412]:
  + 80% low-loss model
  + 20% high-loss model
  + Note: The building type is determined by comparing the random variable with P1, where P1 is the probability of the building type with low loss penetration. If the realization of the random variable is less than P1, the building type is low loss; otherwise the building type is high loss [refer to section 5.3.3 of ITU M.2412].
* FFS for 2-layer Scenario B

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | Support |
| Sony | Support. |
| New H3C | OK |
| QC | Support |

#### ***Initial proposal 2-7-4:***

Adopt the following table for gNB-UE channel model for 2-layer Scenario B (HetNet with Urban Macro and Indoor).

|  |  |
| --- | --- |
|  | **gNB-UE channel model for 2-layer Scenario B** |
| Large-scale channel parameters | FR1:   * Macro TRP to Outdoor UE: UMa in TR 38.901   + Car penetration loss is modelled * Indoor TRP to Indoor UE: the channel model is considered only when the Indoor TRP and Indoor UE are in the same building   + For Indoor office layer: InH-Office in TR 38.901   + For Indoor factory layer: InF in TR 38.901   + Penetration loss is not modelled. * Macro TRP to Indoor UE: UMa in TR 38.901   + O2I penetration loss follows TR 38.901 except that is the real 2D distance between indoor UE and the building wall.     - For the percentage of high loss and low loss building type, 80% low-loss model and 20% high-loss model is considered. * Indoor TRP to Outdoor UE:   + For Indoor office layer: InH-Office in TR 38.901 [TR 38.828 Table 5.2.1.1.2-1]   + For Indoor factory layer: InF in TR 38.901   + Both Car penetration (for outdoor UE) and O2I penetration loss are modelled, wherein, O2I penetration loss follows TR 38.901 except that is the real 2D distance between indoor TRP and the building wall.     - For the percentage of high loss and low loss building type, 80% low-loss model and 20% high-loss model is considered. |
| Fast fading parameters | FR1:   * Macro TRP to Outdoor UE: UMa in TR 38.901 * Indoor TRP to Indoor UE: the channel model is considered only when the Indoor TRP and Indoor UE are in the same building   + For Indoor office layer: InH-Office in TR 38.901   + For Indoor factory layer: InF in TR 38.901 * Macro TRP to Indoor UE: UMa in TR 38.901 * Indoor TRP to Outdoor UE:   + For Indoor office layer: InH-Office in TR 38.901 [TR 38.828 Table 5.2.1.1.2-1]   + For Indoor factory layer: InF in TR 38.901 |

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We don’t think such changes in red is needed.  Take the following in TR38.802 as an example. In the simulation, it is not needed to simulate the real location of each building. Instead, the is in the uniform of e.g., U(0. 25). If we follow the proposal above, companies may need to simulate the real location of each building. From this perspective, the previous agreement is fine, i.e., keeping “O2I penetration loss follows TR 38.901”. No change is needed.   |  |  |  |  | | --- | --- | --- | --- | | Location of UE\_x | Location of UE\_y | Sub-scenario | Penetration loss (for around 4GHz and 2GHz) | | Indoor | Indoor | In different building (if inter-user 2D distance > 50m) | C:\Users\10240317\AppData\Local\Temp\ksohtml2956\wps1.png  C:\Users\10240317\AppData\Local\Temp\ksohtml2956\wps2.png where PLtw=20dB, and C:\Users\10240317\AppData\Local\Temp\ksohtml2956\wps3.png in meter TR 36.814 is the distance from user to internal wall, *i*=*x*, *y,* and *U(a,b)* indicates uniform distribution. | |  |  | In the same building (if inter-user 2D distance ≤ 50m) | C:\Users\10240317\AppData\Local\Temp\ksohtml2956\wps4.png for UEs on different floors TR 36.872; otherwise 0dB. | |
| Huawei, HiSilicon | Even though it is doable to update as “the real 2D distance between indoor TRP and the building wall”, this may unnecessarily complicate the simulator and it is not clear how much this will have impact on the simulation results. Therefore, we prefer the random generation of as stated in TR 38.901. |
| Ericsson | We agree with the above comments. |
| QC | Support, also fine with ZTE suggestion. |

#### ***Initial proposal 2-7-5:***

Adopt the following table for gNB-gNB channel model for 2-layer Scenario B (HetNet with Urban Macro and Indoor).

|  |  |
| --- | --- |
|  | **gNB-gNB channel model for 2-layer Scenario B** |
| Large-scale channel parameters | FR1:   * Macro TRP to Macro TRP: not needed. * Indoor TRP to Indoor TRP: Only the channel model between Indoor TRPs within the same building is considered   + For Indoor office layer: InH-Office in TR 38.901 (hUE =3m).   + For Indoor factory layer: InF in TR 38.901 (hUE =3m).   + Penetration loss is not modelled. * Macro TRP to Indoor TRP: UMa in TR 38.901 (hUE =3m)   + O2I penetration loss follows TR 38.901 except that is the real 2D distance between indoor TRP and the building wall.     - For the percentage of high loss and low loss building type, 80% low-loss model and 20% high-loss model is considered. * Indoor TRP to Macro TRP: same as Macro TRP to Indoor TRP |
| Fast fading parameters | FR1:   * Macro TRP to Macro TRP: not needed. * Indoor TRP to Indoor TRP: Only the channel model between Indoor TRPs within the same building is considered.   + For Indoor office layer: InH-Office in TR 38.901 (hUE =3m). ASA and ZSA statistics updated to be the same as ASD and ZSD.   + For Indoor factory layer: InF in TR 38.901 (hUE =3m). ASA and ZSA statistics updated to be the same as ASD and ZSD * Macro TRP to Indoor TRP: UMa O2I in TR 38.901 * Indoor TRP to Macro TRP: same as Macro TRP to Indoor TRP |

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | Similar comment as above. |
| Huawei, HiSilicon | Support except “ is the real 2D distance between indoor UE and the building wall.” |

#### ***Initial proposal 2-7-6:***

Adopt the following table for UE-UE channel model for 2-layer Scenario B (HetNet with Urban Macro and Indoor).

|  |  |
| --- | --- |
|  | **UE-UE channel model for 2-layer Scenario B** |
| Large-scale channel parameters | FR1:   * Outdoor UE to Outdoor UE:   + Option 1: A.2.1.2 in TR36.843 (\*)   + Option 2: UMi-Street canyon in TR 38.901 (hBS =1.5m)   + Penetration loss between UEs follows Table A.2.1-13 in TR38.802 * Indoor UE to Indoor UE: Only the channel model between Indoor UEs within the same building is considered   + Option 1: A.2.1.2 in TR36.843 (\*).   + Option 2:     - For Indoor office layer: InH-Office in TR 38.901 (hBS =1.5m).     - For Indoor factory layer: InF in TR 38.901 (hBS =1.5m).   + Penetration loss is not modelled. * Outdoor UE to Indoor UE:   + Option 1: A.2.1.2 in TR36.843 (\*).   + Option 2: UMi-Street canyon in TR 38.901 (hBS =1.5m).   + Penetration loss between UEs follows Table A.2.1-13 in TR38.802 except for that as the real 2D distance between indoor UE and the building wall. |
| Fast fading parameters | FR1:   * Outdoor UE to Outdoor UE:   + Option 1: 3D UMi, ASD and ZSD statistics updated to be the same as ASA and ZSA.   + Option 2: UMi-Street canyon in TR 38.901, ASD and ZSD statistics updated to be the same as ASA and ZSA. * Indoor UE to Indoor UE: Only the channel model between Indoor UEs within the same building is considered   + Option 1: A.2.1.2 in TR36.843 (ITU InH), ASD statistics updated to be the same as ASA.   + Option 2:     - For Indoor office layer: InH-Office in TR 38.901. ASD and ZSD statistics updated to be the same as ASA and ZSA.     - For Indoor factory layer: InF in TR 38.901. ASD and ZSD statistics updated to be the same as ASA and ZSA. * Outdoor UE to Indoor UE:   + Option 1: 3D UMi, ASD and ZSD statistics updated to be the same as ASA and ZSA.   + Option 2: UMi-Street canyon in TR 38.901. ASD and ZSD statistics updated to be the same as ASA and ZSA. |
| (\*): For outdoor to indoor case, and indoor to indoor case, use “Remaining Layout Options” in A.2.1.2 of TR36.843 for pathloss calculation, and “ITU-R IMT UMi” for LOS Probability derivation. For outdoor to indoor case, the penetration loss term “20.0+0.5\* din” is excluded in pathloss formula given in A.2.1.2 of TR36.843, and the penetration loss is derived according to Table A.2.1-13 in TR38.802. | |

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | Similar comment as above. |
| Huawei, HiSilicon | Support except “ is the real 2D distance between indoor UE and the building wall.” |
| Ericsson | We might also need to specify the channel model between Macro and Indoor TRP (UMa with outdoor-indoor penetration loss defined in 38.901) |
| QC | Support |

#### ***Initial proposal 2-7-7:***

When UE clustering distribution is used,

* consider the UEs in the same cluster are in the same building
* consider the UEs in different clusters are in different buildings

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | The first bullet is preferred, i.e., consider the UEs in the same cluster are in the same building. Otherwise, the UE-UE interference could be low. |
| Sony | Support. |
| MediaTek | We are fine with the proposal, although we think it is fine to have multiple clusters in one building (e.g., on different floors). |
| Ericsson | We support the proposal, and first bullet is preferred. |
| New H3C | OK |
| QC | Support: “consider the UEs in the same cluster are in the same building” |

#### ***Initial proposal 2-7-8:***

Car penetration loss is modelled as where = 9, σ*P*=5 [as given by subclause 7.4.3 in TR 38.901].

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | Support. |
| Sony | Support. |
| Ericsson | We do not see a need to model car penetration loss for all UEs outdoors. |
| New H3C | OK |
| QC | Support if 30 km/h is baseline. However, for 3km/h, no need to model car penetration loss. |

## Issue#2-8: Others

### Submitted proposal

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| CMCC | ***Proposal 32:*** For comparison between legacy TDD and SBFD, companies should report the assumption of BS transmit power on DL slots and SBFD slots in SBFD operation.   * For calibration purpose, assume the BS transmit power spectrum density is kept the same for SBFD operation and legacy TDD operation. BS transmit power is proportional to the RBs used for DL transmission.   ***Proposal 33:*** The template in the attached document "B1. InH for SBFD Deployment Case 1.zip" for Indoor hotspot scenario is used for collecting SLS evaluation results. |
| Huawei | ***Proposal 6:*** *Adopt the evaluation assumptions of deployment scenarios for SBFD Deployment Case 1-4 in Table A.1 to Table A.1-3.*  ***Proposal 22:*** *For Deployment Case 4, support different operators to use different BS transmit power levels. The candidate power levels are given as follows.*   * *UMa scenario:*   + *Option 1: legacy TDD: 49dBm, SBFD: 53dBm*   + *Option 2: legacy TDD: 53dBm, SBFD: 49dBm* * *Dense Urban Macro layer scenario:*   + *Option 1: legacy TDD: 44dBm, SBFD: 53dBm*   + *Option 2: legacy TDD: 53dBm, SBFD: 44dBm* |
| ZTE | ***Proposal 1****:* *Rel-18 duplex evolution considers the following 6 challenges of legacy TDD system and evaluate the potential gain of subband full duplex.*   * *Challenge ①: Ensuring UL throughput + UL coverage simultaneously.* * *Challenge ②: Ensuring UL throughput + DL&UL Latency simultaneously.* * *Challenge ③: Ensuring UL coverage + DL&UL Latency simultaneously.* * *Challenge ④: Ensuring DL throughput + DL&UL Latency simultaneously.* * *Challenge ⑤: Ensuring DL throughput + UL throughput simultaneously.* * *Challenge ⑥: Ensuring DL throughput + UL coverage simultaneously.*   ***Proposal 10****: Regarding power allocation of gNB for SBFD,*   * *For the case when only K/2 Tx chains are applied, only half of the gNB transmission power can be applied since the PA is bundled with Tx chains.* * *During SBFD symbols, gNB maximum transmission power is not changed due to that partial of RBs are designated as UL subband.*   ***Proposal 12****: For simulation of SBFD deployment case 4,*   * *Different power levels in adjacent carriers can be simulated and it is up to company to report the power levels.* * *Different load levels in adjacent carriers can be simulated and consider the following as baseline.* * *for low load, the adjacent channel interference will be applied with 10% as the probability;* * *for medium load, the adjacent channel interference will be applied with 50% as the probability;* * *for high load, the adjacent channel interference will be applied with 100% as the probability* |
| Ericsson | *Proposal 4: RAN1 to agree the following BS transmit power*   * *For Urban macro, 49 dBm for 100MHz* * *For Dense Urban Macro layer: 44 dBm for 100MHz* * *For FR2-1, replace 200MHz with 100MHz* |
| Qualcomm | **Proposal 9: Support SLS as main tool for the evaluation of subband full duplex study.**   * **LLS could be additional used for the study of inter-UE CLI.** * **Link-budget analysis could be additionally used for the evaluation of coverage gain in SBFD gNB in isolated scenario.**   **Proposal 19**: **Adopt at least the Tx power for the following deployment scenarios following TR 38.901 and TR 38.802**   * **Urban Macro (FR1): 49 dBm per 100MHz as baseline** * **Denser Urban Macro layer: 44 dBm for 100MHz (FR1) and 40 dBm / 100 MHz for FR2-1.** * **Denser Urban Micro layer: 33 dBm/20 MHz (40 dBm/100MHz) for FR1 and [28 dBm]/100 MHz for FR2-1.** * **Indoor office: 24 dBm / 100MHz for FR1 and 23 dBm/100MHz for FR2-1.**   **Proposal 42: RAN 1 shall consider simulation parameters in Tables 8, and 9 for FR1 full duplex evaluation.**  **Proposal 43: RAN 1 shall consider simulation parameters in Tables 8, 10, and 11 for FR2 full duplex evaluation.** |
| DOCOMO | **Proposal 2: Common parameters including power and load levels can be used for deployment case 1 and 4.**  **Proposal 3: For deployment case 4, evaluation of DL/UL performance for SBFD operation and DL performance for legacy TDD operation should be performed.** |
| CATT | **Proposal 9: Performance of dynamic/flexible TDD with existing CLI handling schemes is the baseline for comparison with new CLI handling schemes.**  **Proposal 10: For both FR1 and FR2-1, the simulation assumptions of Indoor office are the same as that of SBFD.**  **Proposal 11: For FR2-1, the simulation assumptions of Dense Urban Macro layer are the same as that of SBFD.**  Proposal 12: Adopt simulation assumptions in Table 2 for HetNet evaluation. |
| OPPO | ***Proposal 1: gNB antenna architecture, TX/RX beamforming and RSIC need be modeled in SLS at least for gNB self-interference.*** |
| Xiaomi | **Proposal 6: Dynamic TDD is not used for legacy TDD for comparison.**  **Observation 2: A baseline combination is needed for the following parameters for easy comparison among companies:**   * **UL/DL traffic generation** * **FTP packet size** * **Channel estimation** * **BS transmit power** * **UE-UE channel model** * **gNB antenna architecture** |
| Spreadtrum | ***Proposal 1: Maximum and minimum BS transmit power in Table 2 should be considered in evaluation of Case 4.***   |  |  |  | | --- | --- | --- | |  | **FR1** | **FR2-1** | | **Urban macro** | * Max: [53/56] dBm for 100MHz * Min: [45] dBm for 100MHz [refer to TR 38.828 Table 5.2.1.4-1] | N.A. | | **Dense Urban Macro layer** | N.A. | * Max: [43] dBm for 200MHz [refer to TR 38.828 Table 5.2.2.4-1] * Min: [40] dBm for 200MHz. EIRP should not exceed 73 dBm. [refer to TR 38.802 Table A.2.1-1] |   ***Proposal 19: BS transmit power spectrum density in SBFD should keep the same value with that in legacy TDD.*** |
| InterDigital | ***Observation 1****. Scenarios on subband non-overlapping (as for inter-subband CLI), subband partial overlapping and subband overlapping (as for intra-subband CLI) may achieve different gains based on at least traffic and/or cell sizes.*  ***Proposal 1.*** *Consider evaluating achieved gain and performance in subband non-overlapping scenario based on inter-subband CLI, and also in subband partial overlapping and subband overlapping scenarios based on intra-subband CLI.* |
| Intel | **Proposal 8: For evaluation of SBFD and dynamic/flexible TDD, the following BS transmit power for legacy TDD are selected:**   * **For Urban macro in FR1- [49] dBm for 100MHz [refer to TR 38.828 Table 5.2.1.4-1]** * **For Dense Urban Macro layer in FR1 - [44] dBm for 100MHz [refer to TR 38.802 Table A.2.1-1]**   **Proposal 9:**   * **For SBFD Deployment Case 4, the same power level is assumed across operators, and power level agreed for case 1 are also adopted for case 4.** |
| Sony | **Proposal 1: Consider dynamic configurations of SBFD frequency and time locations to adapt to changing traffic loads.** |
| Apple | ***Proposal 1: Prioritize scenarios for Deployment Case 1, for which assuming the current signaling available at the scheduler to avoid CLI, UE-to-UE CLI is still the most severe case.***  ***Proposal 2: Full-duplex operation shall not be supported for macro-to-macro scenarios, at least for FR1.*** |
| NEC | Observation 1: Currently following options can be considered for SBFD within a TDD carrier:   * 1. Single BWP containing either UL or DL sub-band (but not both). UL and DL sub-bands are present in different BWPs for enabling SBFD   2. Single BWP containing both UL and DL sub-band(s) |
| Charter Communications | ***Observation 1: CBRS band may suffer from CLI caused by its neighbor bands as the regulations may allow devices to transmit at higher power in these neighbor bands and there is no guard band separating CBRS from these bands. This CLI will affect gNBs as well as UEs in the networks operating in CBRS band.***  ***Observation 2: The permitted frequency placement of SBFD deployment(s) and the flexibility of dynamically switching TDD configurations within these sub-bands impact the CLI caused to legacy networks.***  ***Proposal 1: It is desirable to study the effect of CLI caused by SBFD networks to its adjacent legacy TDD networks using transmit power differences and regulatory OOB emission requirements between CBRS and its adjacent bands (AMBIT and/or C-band) as reference.***  ***Proposal 2: Adopt Table 1 as a reference to finalize the system level simulation parameters to study SBFD deployment case 4.*** |

### Summary

In RAN1#110 meeting, agreement was achieved about BS transmit power for legacy TDD.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agreement**  For evaluation of SBFD and dynamic/flexible TDD, the following BS transmit power for legacy TDD are considered. These values are for the single operator case.   |  |  |  | | --- | --- | --- | |  | **FR1** | **FR2-1** | | **Urban macro** | * Option 1: [53] dBm for 100MHz * Option 2: [49] dBm for 100MHz [refer to TR 38.828 Table 5.2.1.4-1] | N.A. | | **Dense Urban Macro layer** | * Option 1: [53] dBm for 100MHz * Option 3: [44] dBm for 100MHz [refer to TR 38.802 Table A.2.1-1] | * Option 1: [43] dBm for 200MHz [refer to TR 38.828 Table 5.2.2.4-1] | | **Dense Urban Micro layer** | * Option 3: [40] dBm for 100MHz [refer to TR 38.802 Table A.2.1-1] | * Option 2: [33] dBm for 200MHz. EIRP should not exceed 68 dBm. [refer to TR 38.802 Table A.2.1-1 and TR 38.828 Table 5.2.2.4-1] | | **Indoor hotspot** | * Option 2: [24] dBm for 100MHz [refer to TR 38.802 Table A.2.1-1 and TR 38.828 Table 5.2.1.1.2-1] | * Option 1: [23] dBm for 200MHz. EIRP should not exceed 58 dBm. [refer to TR 38.802 Table A.2.1-1 and TR 38.828 Table 5.2.2.4-1] | |

Three companies [Ericsson, Qualcomm, Intel] suggest for down selection among the candidate BS transmit powers for legacy TDD.

* Urban Macro [FR1]:
  + Option 2: 49 dBm for 100MHz [Ericsson, Qualcomm, Intel]
* Dense Urban Macro layer [FR1]:
  + Option 3: 44 dBm for 100MHz [Ericsson, Qualcomm, Intel]
* Dense Urban Micro layer [FR1]:
  + Option 3: 40 dBm for 100MHz [Qualcomm]
* Indoor hotspot [FR1]:
  + 24 dBm for 100 MHz [Qualcomm]

Ericsson suggests to replace 200MHz with 100MHz for BS transmit powers for legacy TDD for FR2-1.

Qualcomm suggests some candidate BS transmit powers for legacy TDD for FR2-1 with 100MHz.

* Dense Urban Macro layer [FR2-1]:
  + 40 dBm for 100 MHz
* Dense Urban Micro layer [FR2-1]:
  + 28 dBm for 100MHz
* Indoor hotspot [FR2-1]:
  + 23 dBm for 100MHz

Considering we are still discussing whether to revise the channel bandwidth from 100MHz to 200MHz for FR2-1, Moderator suggests **Initial proposal 2-8-1** based on the submitted proposals.

Regarding the BS transmit power for SBFD,

* CMCC suggests companies to report the assumption of BS transmit power on DL slots and SBFD slots in SBFD operation for comparison between legacy TDD and SBFD.
  + For calibration purpose, assume the BS transmit power spectrum density is kept the same for SBFD operation and legacy TDD operation. BS transmit power is proportional to the RBs used for DL transmission.
* Spreadtrum suggests BS transmit power spectrum density in SBFD should be kept the same as that in legacy TDD.
* ZTE suggests
  + For the case when only K/2 Tx chains are applied, only half of the gNB transmission power can be applied since the PA is bundled with Tx chains.
  + During SBFD symbols, gNB maximum transmission power is not changed due to that partial of RBs are designated as UL subband.

Moderator suggests **Initial proposal 2-8-2** based on the submitted proposals.

For Deployment Case 4,

* Two companies [DOCOMO, Intel] suggest the same power level across operators.
* Two companies [Huawei, ZTE] suggest different power levels in adjacent carriers can be simulated and it is up to company to report the power levels.
* Spreadtrum suggests to consider Maximum and minimum BS transmit power in evaluation of Case 4.

Moderator suggests **Initial proposal 2-8-3** based on the submitted proposals.

CMCC suggests the template in the attached document "B1. InH for SBFD Deployment Case 1.zip" in R1-2209335 for Indoor hotspot scenario is used for collecting SLS evaluation results.

### 1st Round Proposals

#### ***Initial question 2-8-1:***

Update the agreement made in RAN1#110 for BS transmit power for legacy TDD as below.

* Note: the transmit power for FR2-1 can be discussed later after we decide whether to revise the carrier bandwidth from 100MHz to 200MHz for FR2-1.

For evaluation of SBFD and dynamic/flexible TDD, the following BS transmit power for legacy TDD are considered. These values are for the single operator case.

|  |  |  |
| --- | --- | --- |
|  | **FR1** | **FR2-1** |
| **Urban macro** | * Option 1 (optional): 53 dBm for 100MHz * Option 2 (baseline): 49 dBm for 100MHz [refer to TR 38.828 Table 5.2.1.4-1] | N.A. |
| **Dense Urban Macro layer** | * Option 1 (optional): 53 dBm for 100MHz * Option 3 (baseline): 44 dBm for 100MHz [refer to TR 38.802 Table A.2.1-1] | * Option 1: [43] dBm for 200MHz [refer to TR 38.828 Table 5.2.2.4-1] |
| **Dense Urban Micro layer** | * Option 3: 40 dBm for 100MHz [refer to TR 38.802 Table A.2.1-1] | * Option 2: [33] dBm for 200MHz. EIRP should not exceed 68 dBm. [refer to TR 38.802 Table A.2.1-1 and TR 38.828 Table 5.2.2.4-1] |
| **Indoor hotspot** | * Option 2: 24 dBm for 100MHz [refer to TR 38.802 Table A.2.1-1 and TR 38.828 Table 5.2.1.1.2-1] | * Option 1: [23] dBm for 200MHz. EIRP should not exceed 58 dBm. [refer to TR 38.802 Table A.2.1-1 and TR 38.828 Table 5.2.2.4-1] |

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | In the realistic network, 53dBm for Urban Macro and Dense Urban Macro layer are widely deployed. So we don’t support put 53dBm as optional. We suggest which option is used can be reported by company. |
| Ericsson | We support Huawei’s comments.  Furthermore, we think that realistic RAN4 power limits for WA BS, MR BS and LA BS needs to be reflected in the simulations as well. For example, they are are 53 dBm, 38 dBm, and 24 dBm for FR1. Similarly, realistic values for FR2 also need to be considered. |
| New H3C | OK |
| QC | Support |

#### ***Initial proposal 2-8-2:***

For comparison between legacy TDD and SBFD, companies should report the assumption of BS transmit power on DL slots and SBFD slots in SBFD operation.

* For calibration purpose, assume the BS transmit power spectrum density is kept the same for SBFD operation and legacy TDD operation. BS transmit power is proportional to the RBs used for DL transmission.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK with this proposal.  Another aspect for companies to consider is the following.   * + For the case when only K/2 Tx chains are applied, only half of the gNB transmission power can be applied since the PA is bundled with Tx chains. |
| Huawei, HiSilicon | Support. |
| Sony | Support. |
| Ericsson | Support. |
| New H3C | OK |
| QC | Support |

#### ***Initial proposal 2-8-3:***

For SBFD Deployment Case 4, different power levels in adjacent carriers can be simulated and it is up to company to report the power levels.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Huawei, HiSilicon | Support. |
| Ericsson | Support. |
| New H3C | OK |
| QC | Support, although it may better if RAN1 agrees to some power delta, e.g 0 or 4 dB |

# Issue#3: LLS Evaluation Methodology and link budget analysis

## Issue#3-1: Coverage performance of SBFD

### Submitted proposal

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| CMCC | ***Proposal 34:*** For coverage performance evaluation for SBFD, use option 1.   * Option 1: Take link level evaluation methodology in TR 38.830 (i.e., LLS + Link budget analysis) as starting point to evaluate the coverage performance (e.g., MPL, MCL, MIL) for SBFD.   ***Proposal 35:*** For coverage performance evaluation for SBFD using LLS + Link budget analysis, consider the following simulation assumptions.  Table Simulation assumption for LLS + Link budget analysis for coverage performance evaluation for SBFD.   |  |  | | --- | --- | | Parameter | Value | | Scenario and frequency | FR1 (4GHz): Urban Macro with ISD = 500m | | SBFD subband and slot configurations | Legacy TDD: DDDSU, S=[12D:2G:0U]  SBFD: DXXXU, XXXXU, XXXXX, where X denotes SBFD slot.  For SBFD slot, {DUD} pattern with < ND, NU, NG > = <104, 55, 5> is assumed. | | Target data rates for eMBB | UL 1Mbps | | Pathloss model (select from LoS or NLoS) | Urban: NLoS | | System bandwidth | 100MHz | | Channel model for link-level simulation | TDL-C for NLOS | | Delay spread | 300ns | | UE velocity | 3km/h | | BS antenna configuration | Legacy TDD: =(8,8,2,1,1;2,8) = (0.5, 0.8)λ, +45°/-45° polarization  SBFD: SBFD antenna configuration option-2 (Method 2-1)   * + Two panel groups   + For each panel group: = (8,8,2,1,1;2,8).   + Number of TxRUs: same as legacy TDD   = (0.5, 0.8)λ, +45°/-45° polarization, (da,H,da,V) = (0, 4)λ | | Frequency hopping | w/ or w/o frequency hopping | | BLER | 10% iBLER. | | Number of UE transmit chains | 1, 2 (optional) | | DMRS configuration | For 3km/h: Type I, 1 or 2 DMRS symbol, no multiplexing with data. | | Waveform | DFT-s-OFDM, CP-OFDM (optional) | | SCS | 30kHz | | PUSCH duration | 14 OS | | Repetitions | Legacy TDD: w/o repetition  SBFD: w/ repetition (PUSCH repetition type A) | | HARQ configuration | w/o HARQ | | PRBs/TBS/MCS | Any value of PRBs, and corresponding MCS index, reported by companies will be considered in the discussion.  24 PRB with MCS index = 5 as a starting point. |   ***Proposal 36:*** The following method can be considered for coverage performance evaluation.   * Step 1: Perform LLS for legacy TDD system to get the target SINR (), with which UE can achieve a certain bit rate in UL, and the legacy UE-gNB interference is considered in this case.   + FFS: how to model the legacy UE-gNB interference. * Step 2: Perform LLS for SBFD system to get the target SINR (), with which UE can achieve a certain bit rate in UL, and the legacy UE-gNB interference, gNB self-interference, co-site inter-sector co-channel inter-subband CLI and Inter-site gNB-gNB co-channel inter-subband CLI, are all considered in this case.   + FFS: how to model the interferences. * Step 3: Perform Link budget analysis by reusing the link budget template in TR 38.830 as much as possible to obtain MPL, MCL, and MIL for legacy TDD and SBFD.   + For legacy TDD, is used to calculate MPL, MCL, MIL.   + For SBFD, is used to calculate MPL, MCL, MIL. |
| Huawei | ***Proposal 25:*** *The link level simulation is used to evaluate link level algorithm for SBFD and dynamic/ flexible TDD enhancement.*  ***Proposal 26:*** *The link level simulation and link budget are used to evaluate coverage performance for SBFD. The basic evaluation methodology for coverage is based on link level simulation and link budget, and articulated in 2 steps. The evaluation assumptions for step 1 are provided in Table C.1. Link budget template for step 2 for SBFD is provided in Table C.2.*   * *Step 1: Obtain the required SINR for the physical channels under target scenarios and service/ reliability requirements. Simulations have been conducted neglecting:* * *Constraints imposed by certain beamforming implementation, such as the possibility to simultaneously receive or transmit with maximum gain in more than one direction;* * *PTRS overhead and compensation algorithms.* * *Step 2: Obtain the baseline performance based on required SINR and link budget template.*   ***Proposal 27:*** *Adopt the metrics of MCL, MIL, and MPL for evaluation on coverage performance of Rel-18 NR duplex operation. The definition of these metrics are given as follows.*   * *Definition of MCL:*   + *MCL = Total transmit power – Receiver sensitivity + gNB antenna gain (component 2).*   + *More details can be found in the link budget template shown in Annex C.* * *Definition of MIL:*   + *MIL = Total transmit power – Receiver sensitivity – Tx loss – Rx loss + gNB antenna gain (component 2 + 3 + 4) + UE antenna gain.*   + *More details can be found in the link budget template shown in Annex C.* * *Definition of MPL:*   + *MPL = MIL – Shadow fading margin + BS selection/macro-diversity gain – Penetration margin + Other gains.*   + *More details can be found in the link budget template shown in Annex C.* |
| ZTE | ***Proposal 9****: Consider the following methods for coverage evaluation for SBFD.*  ***Method#1:***  *Step1: Perform SLS for legacy TDD system and get the 5% SINR (SINR#1);*  *Step2: Perform LLS for legacy TDD system to get the target SINR (SINR#2), with which UE can achieve a certain bit rate in UL and DL;*  *Step3: Perform SLS for SBFD system and consider the SBFD interferences in the SLS to get the 5% SINR (SINR#3);*  *Step4: Perform LLS for SBFD system to get the target SINR (SINR#4), with which UE can achieve a certain bit rate in UL and DL;*  *Step5: Compare the gap (SINR#1 – SINR#2) with gap (SINR#3 – SINR#4) to determine if SBFD system can improve the coverage.*  ***Method#2:***  *Step1: Perform SLS for SBFD system and consider the SBFD interferences in the SLS to get the interference levels for the 5%-tile UE;*  *Step2: Perform LLS for SBFD system to get the target SINR, with which UE can achieve a certain bit rate in UL and DL;*  *Step3: Generate a link budget for MPL and input the interference levels in Step1 and target SINR in Step2 in the link budget;*  *Step4: Compare the MPL with legacy TDD system.* |
| Ericsson | Observation 1: It is not necessary to perform link level simulations using separate models for DPD and PA.  Proposal 2: Adopt a net effect model for link-level simulations that captures the essential behaviours of a realistic DPD and PA combination with compliance to the base station ACLR requirements. This requires input from RAN4.  Proposal 3: Adopt a simple crest factor processing model, e.g., hard clipping + bandpass filtering, that captures the essential behaviors of a BS design to increase transmit power. This requires input from RAN4.  Proposal 4: The self-interference channel should be modeled as a set of tapped delay lines directly from TX sub-array ports to RX sub-array ports.  Proposal 5: Self-interference channel coefficients should be based on realistic setups supported by real measurements or high-fidelity electromagnetic (EM) evaluations.  Proposal 6: For both system and link level assessment of SBFD, proper modelling of advanced antennas as well as modelling of beamforming impact on the BS TX to RX isolation should be considered.  Proposal 7: For both system level and link level assessment of SBFD, proper modelling of advanced antennas as well as modelling of beamforming impact on the inter-sector TX to RX isolation should be considered.  Obswervation 2: For FR2, using a structure with RF chokes, 80dB of isolation is achievable over a reasonable bandwidth. Unlike FR1, the isolation does not vary with beam steering.  Proposal 8: Adopt a third order representation model in RAN1 studies to capture the essential behaviors of typical high-gain low noise amplifiers (LNA) in BS receiver chains.  Observation 3: The interference power caused by reciprocal mixing of phase noise in a 40-20-40 MHz SBFD carrier is around -60 to -70 dBc depending on BS implementation.  Proposal 9: Adopt phase noise modelling in RAN1 studies to capture the distortion introduced by high power leakage from the DL sub-bands into the UL sub-bands. The phase noise models in TR 38.803 or those provided by RAN4 during the Rel-17 phase can be adopted as baseline models.  Proposal 10: Adopt modelling of analog filtering, if present, in RAN1 link level studies to capture potential impacts to digital cancellation feasibility and performance.  Observation 4: Adopt explicit digital filtering models in RAN1 link level studies to capture potential impacts to digital cancellation feasibility and performance.  Observation 5: The complexity of digital self-interference cancellation scales with the product of (1) the number of TX chains, (2) the number of RX chains and (3) the effective length of the multi-tap response of the environment and the analog RX frontends.  Observation 6: The original LS to RAN4 does not include questions on the modeling of non-linearities in the gNB Rx chain or modeling of reciprocal mixing of phase noise in the gNB Rx chain.  Proposal 11: Send an LS to RAN4 requesting feedback on various gNB radio aspects that are required for RAN1 to establish evaluation assumptions for link-level simulations. Request feedback on the following gNB aspects:   * + Realistic net effect model for the gNB Tx chain that captures the essential behavior of the following (assuming compliance with base station ACLR requirements):     - DPD + PA combination     - Crest-factor reduction (CFR) + filtering combination   + Realistic model for the gNB Rx chain including     - Non-linearities of the various components e.g., LNA, mixer(s), AGC     - Reciprocal mixing interference to different sub-carriers in the UL subband from the DL subbands due to phase noise   Observation 7: A coverage metric based on the pathloss corresponding to a given certain bit rate is a good metric for system level simulations as it considers realistic beamforming and CLI (Option 2), unlike the MPL obtained from link budget analysis (Option 1 and Option 3).  Proposal 18: RAN1 to define a coverage metric as the target path loss corresponding to a certain (smoothed) average bit rate determined from system simulations: 10Mbps for DL and 1Mbps for UL. This is called “10 Mbps coverage” for DL and “1 Mbps coverage” for UL (Option 2 in the proposal discussed in RAN1 #110) |
| Samsung | *Proposal 16: For LLS, the following components incurring non-linearity should be taken into account.*   * *PA, DPD, and CFR at gNB side and UE side* * *For PA, the starting point is the PA model shared by RAN4 LS in Rel-14 (R1-166004)* * *FFS how to model DPD and CFR*   *Proposal 17: RAN1 should discuss how to model the self-interference channel between TX baseband chain and RX baseband chain. At least the following components can be included.*   * *Internal coupling path, which has fixed delay (almost zero-delay) and fixed power* * *Antenna reflection path, which has fixed delay (very small delay, depending on antenna size) and fixed power* * *Clutter reflection path, which has variable small delay and variable power*   *Proposal 18: For LLS evaluation, consider the following simplified self-interference model.*   * *The self-interference seen at RX baseband chain is modeled as white Gaussian interference with the interference power. Its interference power is decided as in SLS*   *Proposal 19: For LLS evaluation, reuse the performance metric and evaluation assumption in Rel-17 NR Coverage Enhancement WI.*  *Proposal 20: For LLS evaluation, the following uplink channels can be evaluated.*   * *PUSCH and PUCCH* * *FFS: PRACH*   *Proposal 21: For LLS evaluation, consider the following UL transmission schemes.*   * *PUSCH repetition type A and PUSCH repetition type B* * *TB over multiple slots* * *PUCCH repetitions* * *Joint channel estimation* |
| Qualcomm | **Proposal 11:Coverage metric using SLS evaluation to accurately account for inter-gNB CLI.** |
| DOCOMO | **Proposal 5: MPL is used for the coverage evaluation, and link level simulation is performed to derive MPL.**  **Proposal 6: LLS simulation assumptions in TR 38.830 is a baseline for study of duplex enhancement, and additional parameters such as “power difference”, “bandwidth of interference channels/subbands”, and “bandwidth of guard band” are considered.** |
| CATT | **Proposal 4: Use the methodology for R17 coverage enhancement (LLS + link budget analysis) for SBFD and dynamic/flexible TDD coverage evaluation.** |
| Xiaomi | **Proposal 5: The definition provided in Table 1 is adopted for SBFD and dynamic/flexible TDD evaluation.**   |  |  |  | | --- | --- | --- | | Output metric | Definition | Source | | DL/UL received SINR | Received SINR = Effective signal power / (Interference+Noise) |  | | Coverage | The budget template defined for coverage enhancement can be used as a starting point. Self-interference and CLI should be reflected. | TR38.830 | |
| Intel | **Proposal 14:**   * **In order to investigate the performance gain for coverage realized by SBFD, MPL should be also included in the list of performance metrics.**   + **As Rel. 17 NR coverage enhancements studies, RAN1 should focus on link-budget analysis to determine MPL, which already includes MCL/MIL as intermediate steps, with use of LLS evaluations to derive the required SNRs and possibly SLS evaluations to estimate Tx antenna gain correction factor (up to companies).**   + **Simulation assumptions and evaluation methodologies as agreed during Rel-17 NR coverage enhancement SI can be considered as starting points for evaluation of coverage performance for SBFD operation.**   + **Consider Table 1 and Table 2 in the Appendix I for SBFD performance evaluation for FR1 and FR2, respectively.**   + **PUSCH is used as a target channel to meet the following targeted data rates:**     - **For FR1: DL 10Mbps, UL 1Mbps**     - **For FR2: UL 25Mbps, UL: 5Mbps**   + **Discuss further on self-interference modelling for link-level simulations and coverage analysis for SBFD.** |

### Summary

Regarding LLS and corresponding purposes related to SBFD performance and feasibility, the following are raised by companies:

* To evaluate coverage enhancement (CMCC, Huawei, Samsung, Docomo, Intel, Xiaomi, ZTE, CATT),
* To evaluate advanced receivers and realistic demodulation performance due to various interferences (Huawei, Ericsson),
* To evaluate inter-UE CLI on DL performance and guard band requirement (Qualcomm),
* To evaluate inter-gNB and intra-gNB CLI and guard band requirement from a BS perspective (Ericsson),
* To evaluate self-IC performance and feasibility in RAN1, it is important to model the gNB transmit and receive chains with sufficient accuracy including non-linearities. (Ericsson, Samsung),
  + Ericsson thinks the results of the link-level performance evaluations, e.g., X dB suppression, can be used as input for system level simulation so that realistic dB suppression numbers are used in SBFD evaluations, considering that RAN4 LS provides 0-50 dBc value range for digital IC without any analysis of the range or conclusions on the feasibility.
  + Samsung also suggests to consider simplified self-interference model for LLS. The self-interference seen at RX baseband chain is modeled as white Gaussian interference with the interference power. Its interference power is decided as in SLS

Moderator suggests **Initial proposal 3-1-1 and 3-1-2.**

Regarding coverage performance evaluation,

* Eight companies [Huawei, Samsung, DOCOMO, CATT, Intel, Xiaomi, ZTE, CMCC] propose to reuse the link level evaluation methodology in TR 38.830 (i.e., LLS + Link budget analysis) as a starting point to evaluate the coverage performance of SBFD.
  + ZTE also suggests another method for coverage performance evaluation as below:
    - Step1: Perform SLS for legacy TDD system and get the 5% SINR (SINR#1);
    - Step2: Perform LLS for legacy TDD system to get the target SINR (SINR#2), with which UE can achieve a certain bit rate in UL and DL;
    - Step3: Perform SLS for SBFD system and consider the SBFD interferences in the SLS to get the 5% SINR (SINR#3);
    - Step4: Perform LLS for SBFD system to get the target SINR (SINR#4), with which UE can achieve a certain bit rate in UL and DL;
    - Step5: Compare the gap (SINR#1 – SINR#2) with gap (SINR#3 – SINR#4) to determine if SBFD system can improve the coverage.
* Two companies [Ericsson, Qualcomm] suggest to use coverage metric using SLS evaluation, wherein, Ericsson suggest to define the coverage metric as the target path loss corresponding to a certain (smoothed) average bit rate determined from system simulations: 10Mbps for DL and 1Mbps for UL.

Regarding the target channel for coverage performance evaluation,

* PUSCH [Samsung, Intel, CMCC]
* PUCCH [Samsung]

Regarding the metric for coverage performance evaluation,

* MPL, MCL and MIL [Huawei]
* MPL only [DOCOMO, Intel]

CMCC suggests the following method to be considered for coverage performance evaluation.

* Step 1: Perform LLS for legacy TDD system to get the target SINR (), with which UE can achieve a certain bit rate in UL, and the legacy UE-gNB interference is considered in this case.
  + FFS: how to model the legacy UE-gNB interference.
* Step 2: Perform LLS for SBFD system to get the target SINR (), with which UE can achieve a certain bit rate in UL, and the legacy UE-gNB interference, gNB self-interference, co-site inter-sector co-channel inter-subband CLI and Inter-site gNB-gNB co-channel inter-subband CLI, are all considered in this case.
  + FFS: how to model the interferences.
* Step 3: Perform Link budget analysis by reusing the link budget template in TR 38.830 as much as possible to obtain MPL, MCL, and MIL for legacy TDD and SBFD.
  + For legacy TDD, is used to calculate MPL, MCL, MIL.
  + For SBFD, is used to calculate MPL, MCL, MIL.

Moderator suggests **Initial proposal 3-1-3 and 3-1-4.**

### 1st Round Proposals

#### ***Initial proposal 3-1-1:***

RAN1 agrees to perform link-level evaluations for various purposes related to SBFD performance and feasibility in both FR1 and FR2, including but not limited to the following:

* To evaluate coverage enhancement
* To evaluate advanced receivers and realistic demodulation performance due to various interferences
* To evaluate inter-UE CLI on DL performance and guard band requirement
* To evaluate inter-gNB and intra-gNB CLI and guard band requirement from a BS perspective
* To evaluate self-IC performance and feasibility in RAN1, it is important to model the gNB transmit and receive chains with sufficient accuracy including non-linearities
  + The results of the link-level performance evaluations, e.g., X dB suppression, can be used as input for system level simulation so that realistic dB suppression numbers are used in SBFD evaluations

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We are open to consider LLS. However, we don’t think we have to simulate all these aspects. Further down-selection is needed. Coverage enhancement can be selected as the baseline and FFS others. |
| Huawei, HiSilicon | Support to perform LLS at least for the first two bullets and others can be put as FFS. |
| Sony | Isn’t guard band requirement a RAN4 topic? |
| Ericsson | Support. |
| New H3C | OK |
| QC | Support the LLS to evaluate inter-UE CLI on DL performance and guard band requirement |

#### ***Initial proposal 3-1-2:***

For gNB self-interference modelling for LLS in RAN1, the following methods can be used

* Method 1: For purposes of link-level evaluation of performance and feasibility of aspects other than self-interference cancellation, the residual self-interference after cancellation is modelled as white Gaussian noise with power level modelled in a similar way as in SLS
* Method 2: At least for the purpose of link-level evaluation of performance and feasibility of self-interference cancellation:
  + The gNB transmit signals are explicitly generated based on a realistic model of the net-effect of non-linearities in the gNB Tx chain (CFR, DPD, PA) assuming ACLR compliance
  + The gNB receive signals (including self-interference) are explicitly generated based on realistic models of the non-linearities in the gNB Rx chain (LNA, AGC) and a realistic model of the phase noise in the gNB Rx chain
  + Send an LS to RAN4 requesting feedback on the above realistic models for the gNB Tx and Rx chains

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We are open to consider both methods. |
| Huawei, HiSilicon | Fine with Method 1. For Method 2, we think overall the work can be done in RAN4 therefore there is no need to send an LS to RAN4. |
| Ericsson | Support the proposal and send LS to RAN4 |
| New H3C | we are open to discuss about above two menthod. |
| QC | Support Method 1.This proposal depends on outcome of earlier proposal (***3-1-1)*** |

#### ***Initial proposal 3-1-3:***

For coverage performance evaluation for SBFD, use option 1 as baseline, other options are not precluded and can be reported by companies.

* Option 1: Take link level evaluation methodology in TR 38.830 (i.e., LLS + Link budget analysis) as starting point to evaluate the coverage performance (e.g., MPL, MCL, MIL) for SBFD.
* Option 2: Define the coverage metric as the target path loss corresponding to a certain (smoothed) average bit rate determined from system simulations: 10Mbps for DL and 1Mbps for UL. This is called “10 Mbps coverage” for DL and “1 Mbps coverage” for UL.
* Option 3:
  + Step1: Perform SLS for legacy TDD system and get the 5% SINR (SINR#1);
  + Step2: Perform LLS for legacy TDD system to get the target SNR (SNR#1), with which UE can achieve a certain bit rate in UL and DL;
  + Step3: Perform SLS for SBFD system and consider the SBFD interferences in the SLS to get the 5% SINR (SINR#2);
  + Step4: Perform LLS for SBFD system to get the target SNR (SNR#2), with which UE can achieve a certain bit rate in UL and DL;
  + Step5: Compare the gap (SINR#1 – SNR#1) with gap (SINR#2 – SNR#2) to determine if SBFD system can improve the coverage.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| ZTE | We are fine to take Option1 as baseline for progress. We would like to further clarify Option3. The main benefit of Option3 is that we don’t need to simulate interferences in the LLS and we can reuse the SLS as much as possible.   * *Option 3:*   + *Step1: Perform SLS for legacy TDD system and get the 5% SINR (SINR#1) considering the legacy interferences;*   + *Step2: Perform LLS for legacy TDD system to get the target SNR (SNR#1) without considering any interferences, with which UE can achieve a certain bit rate in UL and DL;*   + *Step3: Perform SLS for SBFD system and consider the SBFD interferences in the SLS to get the 5% SINR (SINR#2) considering the legacy interferences and SBFD interferences;*   + *Step4: Perform LLS for SBFD system to get the target SNR (SNR#2) without considering any interferences, with which UE can achieve a certain bit rate in UL and DL;*   + *Step5: Compare the gap (SINR#1 – SNR#1) with gap (SINR#2 – SNR#2) to determine if SBFD system can improve the coverage.*   For example, if SINR#1=0dB and SNR#1=0dB, it means that the legacy TDD can satisfy the coverage requirements. Since SBFD interferences are considered in Step3, SINR#2 may be smaller than SINR#1, let’s assume SINR#2= -2dB in this example. Since UL repetition (and other solutions) can be considered in SBFD system for LLS in Step4, SNR#2 will be smaller than SNR#1, let’s assume SNR#2 = -3 dB. Since (SINR#1 – SNR#1=0) is smaller than (SINR#2 – SNR#2=1), the coverage is improved. |
| Huawei, HiSilicon | Support. |
| Sony | Use Option 1 rather than take discussion time to define yet another set of steps. |
| Ericsson | We support the proposal in principle.  Option 1 does not consider real interference and CLI. Assuming a certain value for the interferences in the link budget analysis does not provide any insights on the feasibility of the value. Therefore, we cannot support Option1.  Option 3 needs further discussions. More efforts could be needed for strict alignments on the simulation assumptions between SLS and LLS to have reliable results.  We think Option 2 can be used as a baseline. Option 2 does not require much simulation effort (if the SLS is considered) since coverage metric in option 2 could be achieved as by-product from SLS. |
| New H3C | OK |
| QC | We prefer that SLS should be used for coverage evaluation as it captures better modeling of self-interference and cross-link interference. Alternatively, LLS-based methodology as in R17 could be used if majority of companies agree to it. |

#### ***Initial proposal 3-1-4:***

For coverage performance evaluation for SBFD based on link level evaluation methodology in TR 38.830, consider the following:

* Step 1: Perform LLS for legacy TDD system to get the target SINR (), with which UE can achieve a certain bit rate in UL, and the legacy UE-gNB interference is considered in this case.
  + FFS: how to model the legacy UE-gNB interference.
* Step 2: Perform LLS for SBFD system to get the target SINR (), with which UE can achieve a certain bit rate in UL, and the legacy UE-gNB interference, gNB self-interference, co-site inter-sector co-channel inter-subband CLI and Inter-site gNB-gNB co-channel inter-subband CLI, are all considered in this case.
  + FFS: how to model the interferences.
* Step 3: Perform Link budget analysis by reusing the link budget template in TR 38.830 as much as possible to obtain MPL, MCL, and MIL for legacy TDD and SBFD.
  + For legacy TDD, is used to calculate MPL, MCL, MIL.
  + For SBFD, is used to calculate MPL, MCL, MIL.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| ZTE | Ok with this framework. |
| Huawei, HiSilicon | ? |
| Ericsson | This proposal seems to be overlapping with Proposal 3-1-3. We are open to discuss the proposal. However, the details on how to model the interferences in the FFSs should be discussed first. |
| New H3C | OK |
| QC | Fine in principles with the three steps procedure. |

# Contact person

Please provide/update the information of the contact person in the following table to facilitate the discussions.

|  |  |  |
| --- | --- | --- |
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