**3GPP TSG RAN WG1 Meeting #102-e R1-200xxxx**

**E-meeting, August 17– 28, 2020**

**Source: Moderator (vivo)**

**Title: Summary of evaluation related issues on supporting NR from 52.6 GHz to 71 GHz**

**Agenda item: 8.2.3**

**Document for: Discussion and decision**

# Introduction

In this contribution, we summarize issues regarding evaluation assumptions and parameters in the Study Item (SI) of supporting NR from 52.6 GHz to 71 GHz for the following email discussion in RAN1 #102-e.

[102-e-NR-52-71-Evaluations] Email discussion/approval on link and system level evaluation assumptions, scenarios and results until 8/20; address any remaining aspects by 8/26 – Huaming (vivo)

Section 2 contains the summary of issues on evaluation assumptions and simulation parameters based on the submitted contributions from agenda 8.2.3 (with several other contributions discussing evaluation related aspects from agenda 8.2.1 and 8.2.2 as well). Section 3 contains some proposed templates for companies to use in the future to report their evaluation results.

# Remaining issues of evaluation assumptions & parameters

In this section, we provide a summary of remaining issues of evaluation assumptions and simulation parameters discussed in the submitted contributions.

## 2.1. Link Level Simulation

### Subcarrier spacing and number of RBs

Table 1. LLS Parameter Set 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter**  **Set 1** | **Evaluation Objectives** | **Carrier Frequency [GHz]** | **Subcarrier Spacing [kHz]** | **Bandwidth [MHz]** | **Number of RB** | **Waveform** |
| **Description** | Primary Objective:  - Evaluation of PDSCH/PUSCH performance including study of phase noise impairment impact for various numerology (i.e. subcarrier spacing, CP length) and possibly for various carrier frequencies.  Evaluation KPI(s) include BLER.  Secondary Objective:  - Evaluation of SSB/PRACH performance including study of phase noise impairment impact for various numerology (i.e. subcarrier spacing, CP length) and possibly for various carrier frequencies.  Evaluation KPI(s) include miss-detection, false alarm. | 60 GHz    Optional: 70 GHz | PDSCH/PUSCH:  - {120, 240, 480, 960} kHz  - FFS: 1920 kHz  Optional:  - if evaluated companies are asked to provide information on other channels/signals and subcarrier spacing | PDSCH/PUSCH:  - {400, 2000} MHz    Optional:  - Companies are asked to provide information if other bandwidths are evaluated  Note: Evaluation of listed channel bandwidth does not mean RAN1 has agreed to support such channel bandwidth and are only for evaluation purposes to obtain useful insights. | For 400 MHz:  - 256 (120 kHz),  - 128 (240 kHz),  - 64 (480 kHz),  - 32 (960 kHz),  - N/A (1920 kHz)  For 2000 MHz:  - N/A (120 kHz),  - N/A (240 kHz),  - FFS (480 kHz),  - 160 (960 kHz),  - 80 (1920 kHz),    For other channel bandwidths:  - Companies are asked to provide information. Companies are encouraged to utilize linearly scaled PRB sizes for a given bandwidth based on above. | For PDSCH:  CP-OFDM  For PUSCH:  CP-OFDM and DFT-s-OFDM |

The above table was agreed in last RAN1 meeting with FFS on 1920 KHz subcarrier spacing and the number of RBs for 480 KHz subcarrier spacing for 2000 MHz channel bandwidth.

It is proposed in [[60], Intel] to add 1920 kHz subcarrier spacing to the subcarrier spacing list for LLS assumptions and to add 320 PRB for 480 kHz subcarrier spacing for 2000 MHz bandwidth with the motivation to gain useful insights on performance. It is further noted these additions to the list are for evaluation purpose only.

On the same topic, it is proposed in [[63], Samsung] to put 1920 kHz SCS as secondary study point, and it is needed only when 960 kHz is not sufficient. It is also proposed no need to further study using 480 kHz SCS for 2000 MHz carrier bandwidth for the concern of the required FFT size would exceed the supported maximum FFT size in Rel-15.

Moderator’s comment:

With the understanding that the list of subcarrier spacing, bandwidth and number of RBs are for evaluation purpose only, having 1920 KHz subcarrier spacing and 320 PRB for 480 kHz subcarrier spacing for 2000 MHz bandwidth as optional in the LLS assumption/parameter list will allow interested companies to evaluate these configurations.

Proposal #1 for discussion:

* For link level evaluation purpose, keep 1920 KHz subcarrier spacing as optional in Table 1.
* For link level evaluation purpose, keep 320 PRB for 480 kHz subcarrier spacing for 2000 MHz bandwidth as optional in Table 1.

Companies are encouraged to provide comments if any.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| NTT DOCOMO | We support both of above as optional. |
| Intel | Agree with Moderator suggestion |
| vivo | Support moderator’s proposal |
| InterDigital | Support Moderator’s proposal |
| Nokia | Agree on proposal |

### Channel model

Table 2. LLS Parameter Set 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter**  **Set 2** | **CP Type** | **Channel Model** | **Antenna Configuration (Mg,Ng,M,N,P)** | **Mobility** |
| **Description** | Normal CP  Extended CP  Note: ECP is not expected to be applicable in all SCS and channel conditions, and companies providing results for ECP are encouraged to provide evaluation results with motivation/justification of simulated ECP cases | TDL model as defined in of TR38.901 Section 7.7.2:  - TDL-A (5ns, 10ns, DS)  - optional DS for consideration: 20ns, 40ns, 60ns DS  CDL model as defined in of TR38.901 Section 7.7.1:  - CDL-B (20ns, 50ns DS)  - CDL-D (20ns, 30ns DS) with K-factor = 10 dB  - optional DS for consideration: 100ns DS  FFS: modification CDL-B/D model  (a) Indoor Office NLOS: CDL-B (20 ns DS), and Indoor Office LOS: CDL-D (20 ns DS)   * Use mean angular spread values from Table 7.5.6-Part2 (for ASD, ASA, and ZSA) and Table 7.5-10 (for ZSD) * Use mean angles of CDL-B/D for desired mean angles as baseline (no angle translation) * Note that the angular spread values in the table are quoted in log units * Mean K-factor for CDL-D from Table 7.5.6-Part2 (~~9~~ 7 dB)   (b) UMi – Street Canyon NLOS: CDL-B (50 ns DS), and UMi – Street Canyon LOS: CDL-D (30 ns)   * Use mean angular spread values from Table 7.5.6-Part1 (for ASD, ASA, and ZSA) and Table 7.5-8 (for ZSD). * Use mean angles of CDL-B/D for desired mean angles as baseline (no angle translation) * Note that the angular spread values in the table are quoted in log units * Use mean K-factor for CDL-D from Table 7.5.6-Part1 (~~7~~ 9 dB)   Note: Mean angular spread values are used as desired AS value to scale the ray angles as described in TR38.901 section 7.7.5.1. As baseline, the ray angles are not translated, meaning (TR38.901 section 7.7.5.1). If companies perform translation of the ray angles they are encouraged to report the details. The mean K-factor is used to scale the tap powers as described in TR38.901 section 7.7.6.  Note: for TDL/CDL model, the delay spread (DS) value mentioned is the delay spread scaling value (i.e. corresponding to normalized delay of 1.0).  Note2: Other models (either TDL or CDL) with DS values not listed are optional.  Note3: Companies are encouraged to provide evaluation results with motivation/justification of simulated DS values. | For TDL model:  - 2x2  - 1x2 (optional)  For CDL model:  Configuration 1:  - (Mg,Ng,M,N,P) = (1,1,8,16,2) BS with (0.5 dv, 0.5 dH)  - (Mg,Ng,M,N,P) = (1,1,4,4,2) UE with (0.5 dv, 0.5 dH)  Configuration 2:  - (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  - (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH) | 3 km/hr |

The above table was agreed in last RAN1 meeting with FFS on modification to CDL models.

In [[15], Ericsson], it is observed that without proper randomization of the relative UE-gNB array orientations, the delay spread statistics can be substantially under-estimated. It is also observed that a single panel UE, or a dual panel UE with one panel fully/partially blocked, experiences larger delay spreads than a dual panel UE without any blocking.

Regarding the modification to CDL channel models, it is observed in [[60], Intel] that the measured RMS delay spread after Tx/Rx beamforming from the scaled ray angles based on indoor office scenario and UMi street canyon of the modified models are similar to the measured RMS delay spread after Tx/Rx beamforming for original CDL-B/CDL-D model. Furthermore, it is observed that the scaling of the power and angle values using Indoor office LOS or UMi street canyon LOS for the modified models have little impact to the power delay profile (as the power of the tap wih larger delays are below -30 dB compared to the main tap). Based on the observation that TDL-A model with some delay spread value is a good approximation of the channel characteristics modeled by CDL-B model, [[60], Intel] proposes that the FFS modification to CDL-B is not needed and instead of the FFS modification, add 20 ns DS to the TDL-A channel model in addition to 5 ns and 10 ns.

Moderator’s comment:

Recall that this channel model and associated delay spread values have been extensively discussed in the last RAN1 meeting, it would be good to finalize the channel and associated delay spread values so that companies can evaluate and submit results. It seems reasonable to keep original CDL models without modifications and add 20 ns DS to the TDL-A channel model as baseline to investigate large delay spread impact.

Proposal #2 for discussion:

* Keep modification CDL-B/D model in Table 2 as optional and add 20 ns DS to the baseline TDL-A channel model in addition to 5 ns and 10 ns.

Companies are encouraged to provide comments if any.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| NTT DOCOMO | Support |
| Intel | Agree with moderator suggestion.  On the UE antenna field pattern rotation which was newly proposed by Ericsson, while we understand the motivation for this, it order to properly model the UE antenna field pattern, we would need to implement 2 back to back panels and panel selection such that UE may have some good EIS. This will complicate the model quite significantly, without proper modeling it just mimic something with fixed cluster position, which just generates bias in the channel statistics.  The more straight forward approach would be to actually randomly generate the cluster rays using the SLS channel model.  For capturing the correct ISI impact, we suggest to utilize SLS and derive meaningful metric in SLS, instead of changing the LLS channel model. |
| vivo | Support moderator’s proposal |
| InterDigital | Support Moderator’s proposal |
| Nokia | Agree with the proposal. |

### RF impairment modelling

Table 3. LLS Parameter Set 3

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter Set 3** | **PA Model** | **gNB TRP PN Model** | **UE PN Model** | **Pre-loaded Tx EVM** | **Additive Rx EVM** | **I-Q Imbalance** | **Frequency Offset** |
| **Description** | Optional:  - Companies to provide modeling (in lieu of pre-loaded Tx EVM) | 3GPP TR38.803 example 2 BS PN profile  Optional:  - If other PN profile is used, companies to provide information on the modeling used  Note: companies to provide information about the LO distribution model assumed in the simulations. | 3GPP TR38.803 example 2 UE PN profile  Optional:  - If other PN profile is used, companies to provide information on the modeling used  Note: companies to provide information about the LO distribution model assumed in the simulations. | Optional:  - 3% at Tx (In lieu of PA model),  - If other values are used companies are asked to provide information on the values selected for simulation. | Optional:  - 5% at Rx,  - If other values are used companies are asked to provide information on the values selected for simulation. | Optional:  - (-26dBc),  - (-31dBc),  - If other values are used companies are asked to provide information on the values selected for simulation. | Optional:  - 0.1 ppm (for PDSCH/PUSCH)  - 5, 10, 20 ppm (for initial access) |

The above table was agreed in last RAN1 meeting. In [[4], vivo], it is proposed to model I/Q imbalance in LLS.

Moderator’s comment:

Currently, companies are allowed to model I/Q-imbalance and other RF impairments with optional modeling. It seems no need to discuss further.

Companies are encouraged to provide comments if any.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| Intel | Agree with moderator suggestion |
| vivo | Fine with moderator’s proposal. However, it should be clarified that the problem identified by optional modeling still needs to be studied. |
| InterDigital | Support Moderator’s proposal |
| Nokia | No further requirements. |

### Other issue(s)

Please provide other issue(s) if any on LLS that requires resolution in this meeting.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
|  |  |
|  |  |
|  |  |
|  |  |

## 2.2. System Level Simulation

### Evaluation metric, subcarrier spacing, bandwidth and number of RB

Table 4. SLS Parameter Set 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter Set 1** | **Evaluation Objectives** | **Carrier Frequency [GHz]** | **Subcarrier Spacing [kHz]** | **Bandwidth [MHz]** | **Number of RB** |
| **Description** | Primary objective:  - Evaluation of single operator and multi-operator deployments including study of interference impact and coexistence between nodes.  Evaluation KPIs include user throughput, latency, average buffer occupancy, ratio of mean served throughput and offered cell throughput, and resource utilization.  Secondary objective:  - obtain delay spread profiles (and inter-symbol interference statistics) for deployment scenarios of interest (note: performance impact from delay spread should be conducted in LLS, the SLS would be used to supplement findings) | 60 GHz    Optional: 70 GHz | For 2000MHz BW:  960 kHz  FFS: 120, 240, 480 kHz  For 400MHz BW:  120 kHz  FFS: 240, 480, 960 kHz  Note: Other than value above, companies are encouraged to evaluating using subcarrier spacing values determined to be feasible from LLS study. Values for the subcarrier spacing may be revisited after further investigation from LLS study. | 2000 MHz  400 MHz (FFS: optional)  Note: Channel bandwidth evaluated may be revisited after further investigation. | For 2000 MHz:  - N/A (120 kHz),  - N/A (240 kHz),  - FFS (480 kHz),  - 160 (960 kHz),  - 80 (1920 kHz),  For 400 MHz:  - 256 (120 kHz),  - 128 (240 kHz),  - 64 (480 kHz),  - 32 (960 kHz),  - N/A (1920 kHz)    For other channel bandwidths:  - Companies are asked to provide information. Companies are encouraged to utilize linearly scaled PRB sizes for a given bandwidth based on above. |

#### Evaluation metrics

It is proposed in [[60], Intel] to use root mean square effective channel delay spread at the receiver as a metric for system level evaluation of NR in 52.6–71GHz. [[60], Intel] also proposes to use intersymbol interference signal to interference ratio as a metric for system-level evaluation with details given on assumptions of the acceptable intersymbol interference level criteria and of the dynamic FFT window placement for intersymbol interference SIR calculation.

Moderator’s comment:

Obtaining delay spread profiles and inter-symbol interference statistics are already agreed to be the secondary objective for SLS. Interested companies can for sure use them as the metrics in their evaluation. It seems no need for further discussion and agreement.

Companies are encouraged to provide comments if any.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| Intel | We understand moderator comments. We would like to note that such secondary metric should be also captured into the TR so that useful information could be shared as part of this SI. |
| vivo | Support moderator’s proposal |
| InterDigital | Support Moderator’s proposal |
|  |  |

#### Subcarrier spacing, bandwidth and number of RBs

It is proposed in [[63], Samsung] that no need to further study using 480 kHz SCS for 2000 MHz carrier bandwidth for the same concern as expressed for LLS evaluation. There’s no other explicit proposals made in the submitted contributions on these FFS aspects in Table 4.

Moderator’s comment:

There’re several companies submitted their preliminary SLS evaluation results in the contributions to this meeting. On the used subcarrier spacing and bandwidth for submitted SLS results, it is observed that six sources [[59], ZTE; [66], Nokia; [67], Huawei; [33], vivo; [54], Qualcomm; [41], Ericsson] used (960 KHz SCS, 2000 MHz BW) for SLS. One source [[25], NTT DOCOMO] used (120 KHz with 400 MHz BW and 960 KHz SCS with 2000 MHz BW). It may be good to have a small set of configurations as baseline and keep other FFS configurations as optional so that more companies may be able to generate SLS results with baseline configurations while still allowing interested companies to evaluate with other parameters.

Proposal #3 for discussion:

* For SLS performance evaluations purpose, keep 120, 240 and 480 kHz as optional subcarrier spacing for 2000 MHz BW and keep 240, 480 and 960 kHz as optional subcarrier spacing for 400 MHz BW in Table 4.
* For SLS performance evaluations purpose, keep 400 MHz as optional bandwidth in Table 4.
* For SLS performance evaluations purpose, keep 320 PRB for 480 kHz subcarrier spacing for 2000 MHz bandwidth as optional in Table 4.

Companies are encouraged to provide comments if any.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| NTT DOCOMO | We support 1st and 3rd bullet.  For the 2nd bullet, we prefer to keep 400 MHz BW as mandatory. |
| Intel | We are ok with moderator’s proposal #3 |
| Vivo | Support moderator’s proposal |
| InterDigital | Support Moderator’s proposal |
| Nokia | Okay with bullet #1.  For bullet #2, we have a similar view to DOCOMO to have 400 MHz as a mandatory bandwidth.  Okay with bullet #3. |

### Scenarios

Table 5. SLS Parameter Set 2

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter Set 2** | **Deployment Scenario** | **UE distribution** | **Channel Model** |
| **Description** | **Primary scenarios:**  - Scenario indoor-A or C (FFS: which scenario is primary)  **Secondary scenarios:**  - Scenario indoor-C or A (FFS: which scenario is secondary)  - Scenario outdoor-B  **Optional:**  - other scenarios listed below  **Indoor Office:**  **Scenario Indoor-A)** InH open office model:  Office box 120m x 50 m, 12 BS per operator, 2 operator, BS height at 3m (ceiling), UE height 1m, ISD = 20m, BS randomly deployed within 10m x 10m virtual box  FFS: if the office box can be reduced down to 50m x 50m  FFS: minimum distance between BS    **Scenario Indoor-B)** small InH open office model:  Office box 20m x 20 m, 1 BS per operator, 2 operator, BS height at 3m (ceiling), UE height 1m, BS randomly deployed within 10m x 10m virtual box  FFS: minimum distance between BS    **Scenario Indoor-C)** InH open office model:  Office box 120m x 50 m, 12 BS per operator, 1 operator, BS height at 3m (ceiling), UE height 1m, BS fixed position, ISD = 20m  FFS: if the office box scenario can be reduced down to 50m x 50m    **Scenario Indoor-D)** InH open office model:  Office box 120m x 50 m, 6 BS per operator, 2 operator, BS height at 3m (ceiling), UE height 1m, BS fixed position, ISD = 20m  FFS: if the office box scenario can be reduced down to 50m x 50m    **Scenario Indoor-E)** InH open office model:  Office box 120m x 80 m, 3 BS per operator, 2 operator, BS height at 3m (ceiling), UE height 1m, BS fixed position, a=20m, b=40m, c=20m, and d=40m  image001  **Dense Urban:**  **Scenario Outdoor-A)** Dense Urban with 1 layer  Hexagonal grid, single layer, 3 sectors per site, 7 sites locations, BS height 10m, UE height 1.5m, ISD = 150m  FFS: whether ISD needs to be smaller  FFS: Reducing deployment size from 7 sites to 1 site for performance evaluations with both single and two operator scenarios.    **Scenario Outdoor-B)** Dense Urban with 2 layers  Macro layer (sub 7GHz – not necessarily need to be simulated for the 60GHz evaluation):  Hexagonal grid, single layer, 3 sectors per site, 7 sites locations  BS height 25m, UE height 1.5m, ISD = 100m, fixed BS position  Micro layer (above 52.6 GHz):  BS height 10m, UE height 1.5m, 2 operator, 2 BS per hexgrid per operator, random position within macro hexagonal grid per operator, minimum distance between TRP and UE: 10m  FFS: Reducing deployment size from 7 sites to 1 site for performance evaluations with both single and two operator scenarios.    **Scenario Outdoor-C)** Dense Urban with 1 layer  Hexagonal grid, single layer, 3 sectors per site, 3 sites locations, BS height 10m, UE height 1.5m, ISD = 150m    **Indoor Factory Hall:**  **Scenario Factory-A)** Indoor factory with Dense cluster & low BS (InF-DL)  Grid, 300m x 150m x 10m factor hall  ISD 50m, BS height 1.5m, UE height 1.5m, Typical clutter size 2m, Clutter height 6m, Clutter density 60%  **Scenario Factory-B)** Indoor factory with sparse clutter & High BS (InF-SH)  Grid, 300m x 150m x 10m factor hall  ISD 50m, BS height 8m, UE height 1.5m, Typical clutter size 10m, Clutter height 2m, Clutter density 20% | Average of 5 or 10 UE per BS    UE are either 100% indoor or 100% outdoor depending on deployment scenario. | InH open office:  - gNB-to-gNB and gNB-to-UE links: InH – office channel & PL model from TR38.901  - UE-to-UE links: [InH – office channel & PL model from TR38.901]    Dense Urban:  - gNB-to-gNB and gNB-to-UE links: UMi street canyon channel & PL model from TR38.901  - UE-to-UE links: [D2D channel & PL model from TR36.843 Section A.2.1.2]    Indoor factor:  - gNB-to-gNB and gNB-to-UE links: InF channel & PL model from TR38.901  - UE-to-UE links: [InF channel & PL model from TR38.901]  Note: 3D distance between an gNB and a UE is applied. 3D distance is also used for LOS probability and break point distance.  Note: channel models in brackets, [ ], are working assumption and may be revisited. |

The above table was agreed in last meeting regarding evaluation scenarios with several FFS left. In this meeting, multiple contributions have provided their views and proposals on these aspects.

#### (High priority) Primary scenario

It is proposed in [[63], Samsung] to take both indoor-A and indoor-C scenarios as primary scenarios for different number of operators in SLS. While [[60], Intel] proposes to have indoor scenario C as the primary scenario and indoor scenario A as secondary scenario with the reason hoping to get more evaluation results in primary scenario for alignment and draw meaningful conclusions.

Moderator’s comment:

Considering the reason to define a primary scenario is to encourage more companies to submit results with an aligned scenario and hopefully to draw meaningful conclusion, it’s important to resolve this issue in this meeting. Regarding this primary and secondary scenario issue, multiple options below were discussed with no agreement in the last RAN1 meeting:

* Option 1) Indoor-A as primary, Indoor-C as secondary
* Option 2) Indoor-C as primary, Indoor-A as secondary
* Option 3) Indoor-A or Indoor-C as primary
* Option 4) Indoor-A and Indoor-C as primary

Without further discussion on the placement of the 2nd operator’s BS, Indoor-C may be fine only for single operator deployment evaluation. Though that single operator evaluation can be implemented with Indoor-A as well as shown in some submitted contributions. There’re several companies submitted their preliminary SLS evaluation results in the contributions to this meeting. On the used scenarios for the submitted SLS results, the following is observed.

Three contributions [[59], ZTE; [66], Nokia; [33], vivo] used indoor-A. [[54], Qualcomm; [57], Nokia] used a layout half of the size of indoor-A with 2 operators each with 6 gNBs. [[41], Ericsson] submitted results for both indoor-A and indoor-C. [[67], Huawei] submitted results for indoor-A, indoor-B and indoor-C scenarios. [[25], NTT DOCOMO] submitted results for indoor-C. Furthermore, on the minimum distance between BS of different operators, it is stated as 3 m in [[67], Huawei], 2 m in [[57], Nokia] and 1 m in [[41], Ericsson].

Proposal #4 for discussion:

* For SLS performance evaluations purpose, choose one of the following options as the primary scenario in Table 5.
  + Option 1) Indoor-A as primary, Indoor-C as secondary
  + Option 2) Indoor-C as primary, Indoor-A as secondary
  + Option 3) Indoor-A or Indoor-C as primary
  + Option 4) Indoor-A and Indoor-C as primary
* For SLS performance evaluations purpose, the minimum distance between BS of different operators is [2] m for indoor-A and indoor-B scenario in Table 5.

Companies are encouraged to provide comments on their preference of the above options and on the value of minimum BS distance.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| NTT DOCOMO | For the 1st main bullet, we support option 2. |
| Intel | Our preference is option 2, as mentioned that main motivation to encourage more companies to bring results for a slightly more simple deployment setup. We do not mean to say that Indoor-A is less prioritized or less important.  For the minimum distance for BS-BS, we are ok with the suggestion |
| vivo | Support Option 1; Support minimum distance=2m |
| InterDigital | Support option 2. |
| Nokia | Option 1) Indoor-A as primary, Indoor-C as secondary  Nokia supports a minimum distance of 2 m for indoor-A. |

#### Indoor scenario area reduction

There was an FFS on reducing the simulation layout for indoor scenarios to help with simulation complexity In [[60], Intel], RSRP CDFs were compared on different size of layouts. Then it proposes to have indoor deployment scenario A and C to be 50 m x 100 m deployment with 10 BS per operator.

Moderator’s comment:

It is noted [[54], Qualcomm; [57], Nokia] used a layout half of the size of indoor-A (i.e. 50 m x 60 m) with 2 operators each with 6 gNBs in their submitted SLS results but no proposal on the area reduction was made.

Proposal #5 for discussion:

* Regarding indoor scenario area reduction for indoor-A and indoor-C in Table 5, choose one of the following options:
  + Option 1) Keep 50 m x 120 m as it is
  + Option 2) Change into 50 m x 100 m deployment with 10 BS per operator

Companies are encouraged to provide comments on their preference of the above options or other values.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| NTT DOCOMO | We prefer option 1. |
| Intel | We are ok with either option 1 or 2. Option 2 was suggested in case companies did want to simulation something smaller scale without meaningfully impacting overall signal/interference strength statistics. |
| vivo | Option 1. We don’t see strong motivation to change the layout. |
| InterDigital | Option 1. |
| Nokia | Nokia prefers third option with ½ size reduction of Indoor-A (50 m x 60 m) with 6 gNBs per operator as this provides similar results to the full size Indoor-A The motivation is reduce the simulation times.  Option 2 is only 17% smaller than Option 1 so there is effectively little difference in the choice between options 1 or 2. In the last meeting, there was an FFS: if the office box can be reduced down to 50m x 50m. That would be preferred if we cannot agree on ½ size |

#### Outdoor Scenario

For outdoor scenario simulation, [[41], Ericsson] proposes to have the minimum distance between micro gNBs’ of same operator in the same sector as 10 m. [[41], Ericsson] also proposes for outdoor scenario simulation, reduce the deployment size from 7 sites to 1 site.

Moderator’s comment:

The minimum distance between micro gNBs of the same operator in the same sector is indeed a missing aspect. It also makes sense to reduce the number of sites for simulation burden consideration.

Proposal #6 for discussion:

* For SLS performance evaluations purpose, the number of sites in outdoor scenarios-A and B in the deployment scenario field of Table 5 is reduced from 7 to 1.
* For SLS performance evaluations purpose, the minimum distance between micro gNBs’ of the same operator in the same sector is 10 m for outdoor scenarios in the deployment scenario field of Table 5.

Companies are encouraged to provide comments if any.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| NTT DOCOMO | For the 1st bullet, our current preference is 7 sites as mandatory and 1 site as optional since we think the number of sites may have considerable impacts on geometry distribution. If no/less impact is observed depending on the number of sites, we would be okay with 1 site. |
| Intel | We would like to have bit more time to conduct investigation on this issue. We suggest to leave this FFS. |
| vivo | Support moderator’s proposal |
| InterDigital | We are fine with the proposed minimum distance. But, we prefer to have 1 site scenario as optional to allow simpler evaluation but not mandate the scenario. |
| Nokia | Support reducing the scenario from 7 to 1 as a baseline with 7 sites as optional. For the 1 site case, we feel that outdoor scenario C is an equivalent and better solution as the transmitters are placed on the edge eliminating any need to model wrap-around. If 1-site scenario B is selected, than perhaps wrap-around will be necessary.  Support the minimum distance between micro gNBs of same operator as 10m. Further propose that the minimum distance between micro gNBs of different operators should also be 10m. Lastly, the 10m minimum distance should be true across sectors as well as in sectors. (Justification: 10m is the minimum distance (2D) supported by the UMi model.)  The microcell placement method should be further clarified. The minimum distance to the macro cell should also be specified and be 10 m. |

### Traffic model and cell selection

Table 6. SLS Parameter Set 6

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter Set 6** | **TDD DL/UL Ratio** | **CSI feedback** | **Additive Rx EVM** | **Traffic Model** | **UE Receiver** | **Cell selection criteria** | **DL/UL Traffic Ratio** |
| **Description** | Companies to provide information (if applicable) | Ideal feedback | Note: additive Rx EVM values may be revisited after LLS study | FTP Model 3 (27Mbyte file)    Optional:  - Full buffer,  - FTP Model 1 (27 Mbyte file),  - FTP Model 3 (0.5, 2, 16 Mbyte file) | MMSE-IRC | Random select from strongest RSRP with 1 dB HO Margin  Note: UE with RSRP below a P\_threshold are not considered in simulation and counted toward UE distribution count  FFS: value of P\_threshold. (including the possibility of negative Inf) | 50% DL, 50% UL    Optional:  100% DL, 0% UL,  80% DL, 20% UL  0% DL, 100% UL |

#### UE cell selection

The above table was agreed in last RAN1 meeting for SLS. Regarding RSRP threshold for cell selection, there’re several contributions discussing this FFS issue.

[[41], Ericsson] proposes that UE with RSRP lower than -76 dBm are not considered in the simulations. The reason for that is in NR, UE is required to be able to detect SSBs with SNR as low as -5dB. Based on that, the UE association should at least be limited to UE that are able to detect DL RSRP of -76 dBm and higher.

The contribution [[60], Intel] proposes to adopt “-68 dBm + 10 log10( BW/2GHz )” as the RSRP threshold for user selection and “-infinity dBm” as optional RSRP threshold for user selection. The argument for -68 dBm (at 2 GHz system bandwidth) is that in unlicensed operations, system may need to operate with the assumption that UEs may only perform single shot detection of SSB, which would require the SSB detection requirement to be about 6 dB higher and near 0 dB SNR. The optional value of –infinity is to study the total implication of UE association in deployments.

Moderator’s comment:

For the contributions submitted with SLS results, not many details on UE cell selection criteria are described in the contributions submitted to this meeting. It may not be able to gain insight if no details are reported.

Proposal #7 for discussion:

* For SLS performance evaluations purpose, choose one of the following options as the baseline RSRP threshold for cell selection (UE with RSRP below this threshold are not considered in simulation and counted toward UE distribution count) in the Cell selection criteria field of Table 6.
  + Option 1) -76 dBm
  + Option 2) -68 dBm + 10 log10( BW/2GHz )
* For SLS performance evaluations purpose, “-infinity dBm” is an optional RSRP threshold for cell selection (UE with RSRP below this threshold are not considered in simulation and counted toward UE distribution count) in the Cell selection criteria field of Table 6.
* Note: companies are required to report what value is used as the RSRP threshold for cell selection

Companies are encouraged to provide comments on their preference of the above options or other values.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| NTT DOCOMO | For the 1st bullet, assuming RSRP is measured with SSB, which should be common with any bandwidth, option 1 is reasonable in our view.  For the 2nd bullet, we think it could be considered as optional since it seems to evaluate a special case where only 60 GHz NW is deployed and UE has to connect even when measured RSRP is quite poor. |
| Intel | We are generally ok with moderator’s proposal #7. However, we should selection between option 1 or 2.  Between option 1 and 2, our preference is option 2. However, we are open for discussion on the reference value of -68dBm. The -68dBm was something that came from Ericsson in the last meeting. We agreed this could be used.  One thing to note is that if -76dBm is used for all system bandwidths, for 2 GHz system this would be having a threshold at -5dB SNR for 10dB NF UEs and -8dB SNR for 13dB NF UEs, and for 400 Mhz system, this would be having a threshold at 2dB SNR for 10dB NF UEs, and -1dB SNR for 13dB NR UEs. This seems to be selecting quite different deployment scenario just by fixing the RSRP threshold.  Therefore, if threshold is to be introduced, we should have one for different system bandwidths.  As for NTT DOCOMO’s comments on RSRP measurement. We are not entirely sure if companies are actually performing RSRP measurement using SSB. We note that depending on setup the SSB SCS could be different and this could lead to different bandwidth. Our understanding is that SSB is abstracted in the SLS and the RSRP is performed directly using the equations provided for SLS using the system bandwidths configured. Therefore, there would be some impact from different system bandwidths.  In any case, we thinks there is value for some discussion here. |
| vivo | Option 2 |
| InterDigital | Option 2 |
| Nokia | Nokia supports “-infinity dBm” as a primary RSRP threshold and report how many UEs in the coverage fall below the -76 dBm. |

#### FTP traffic model packet size

In [[60], Intel], an issue was raised regarding traffic model packet size. It is observed that 27 Mbytes packet size causes long average packet delay and significant simulation run time. It is proposed to change the file/packet size from 27 Mbyte to [1] Mbyte.

Moderator’s comment:

There’re several companies submitted their preliminary SLS evaluation results in the contributions to this meeting. On the used FTP traffic model packet size for submitted SLS results, it is observed that several contributions [[59], ZTE; [66], Nokia; [67], Huawei; [33], vivo; [41], Ericsson; [25], NTT DOCOMO] used 27 Mbytes as in baseline for SLS while [[54], Qualcomm] used optional 2 Mbytes.

Proposal #8 for discussion:

* Regarding the baseline FTP traffic model packet size, choose one of the following options:
  + Option 1) Keep 27 Mbytes as it is
  + Option 2) Change into [1] Mbytes

Companies are encouraged to provide comments on their preference of the above options or other values.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| NTT DOCOMO | Support Option 1, since it can be considered as higher throughput services which are typical for application on high frequency range in our view. |
| Intel | This was an issue that we brought up. Basically, 27Mbyte file sizes for packet generation does not seem to depict any real traffic packet sizes. Furthermore, cause some instability issues at the beginning of the simulation.  The high throughput traffic can be modeled with higher arrival rate, and it was not immediately clear why the file size was increased. We suggest using something small and increase the arrival rate to control flow of the traffic load.  We are open to the exact size, as long as it is around 0.5 ~ 2 MB size region. |
| vivo | Option 1 but open to Option 2 |
| InterDigital | We are fine with changing the packet size, but we have concerns that opening new issues would delay the progress of the SI. Given the limited time of the SI, we are fine with Option 2 if we can make a quick consensus. Otherwise, we prefer Option 1. |
| Nokia | Option 1) Keep 27 Mbytes as baseline with an option to simulate smaller packet sizes. |

### Channel access modelling

Table 7. SLS Parameter Set 7

|  |  |  |
| --- | --- | --- |
| **Parameter Set 7** | **Channel access modeling** | **Synchronization Assumption** |
| **Description** | Companies to report details of LBT procedure and parameters (e.g. ED, CWmax, COT, etc.) if LBT procedure is used in the evaluations. | Companies are asked to provide information on the synchronization assumption made between operators for 2 operator deployment scenarios. |

The above table was agreed in last meeting. In contribution [[33], vivo], it was proposed to align the LBT procedure and parameters in coexistence evaluation between companies to facilitate the calibration.

Moderator’s comment:

It might be useful to decide a baseline LBT procedure and parameters for evaluation result calibration purpose. However, considering the discussion on channel access mechanism in agenda 8.2.2 and related regulations are still on-going, such a baseline LBT procedure and parameters may be hard to be agreed upon in limited time. Given companies are required to report details of LBT procedure and parameters if used in SLS from last meeting’s agreement. It seems no need to discuss further on a baseline LBT procedure and parameters if it’s for evaluation purpose only.

If a baseline LBT procedure and parameters can be agreed in agenda 8.2.2, then it’s beneficial to have the same baseline LBT procedure and parameters in evaluation.

Companies are encouraged to provide comments if any.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| Intel | We agree with vivo’s suggestion. We noticed that in channel access discussion thread there is different understanding our how LBT needs to be performed. We believe it will be extremely valuable to have a reference LBT model for evaluations. |
| vivo | Agreed that the baseline LBT procedure and parameters in 8.2.2 could be used in SLS evaluation. However, the method of energy calculation for directional LBT should be clarified, i.e. with or without beamforming gain when CCA check. |
| InterDigital | We support having the same baseline LBT procedure and parameters in evaluation. |
|  |  |

### Other issue(s)

Please provide other issue(s) if any on SLS that requires resolution in this meeting.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
|  |  |
|  |  |
|  |  |
|  |  |

# Template for evaluation results

## 3.1. Link Level Simulation

There’re several companies submitted their LLS evaluation results to this meeting. Due to different result presentations and different assumptions/parameters are used in the contributions, it is hard to compile and collect all the submitted results. Furthermore, it is difficult to compare results in contributions by reading directly from for example, BLER curves.

To facilitate collecting results into the TR for meaningful observations and conclusions, it is recommended for companies to at least use a template to capture LLS results for next meeting. Note that, in additional to the templates/tables, companies can still submit results in other forms (e.g., BLER curves). Some templates similar to what are used in [[26], Qualcomm] have been proposed in below.

Proposal #9 for discussion:

* It is recommended to use the following template in Table 8 to capture the primary LLS performance metric of PDSCH/PUSCH BLER.
* It is recommended to use the following templates in Table 9 and Table 10 to capture the secondary LLS performance metrics of SSB and PRACH performance.

Table 8. LLS template: SINR in dB achieving PDSCH/PUSCH BLER of 10%

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-xxxxxxx / Source 1 | 7 | TDL-A, 5ns |  |  |  |  |  |
| TDL-A, 10ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 16 | TDL-A, 5ns |  |  |  |  |  |
| TDL-A, 10ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 22 | TDL-A, 5ns |  |  |  |  |  |
| TDL-A, 10ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| Additional report/notes:   1. CP type 2. antenna configuration for CDL model 3. waveform in case of PUSCH 4. PTRS configuration 5. DMRS configuration 6. any optional or other assumption/parameters used not as in the baseline | | | | | | |

Table 9. LLS template: SINR in dB achieving PSS/SSS detection probability of 90%

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-xxxxxxx / Source 1 | TDL-A, 5ns |  |  |  |  |
| TDL-A, 10ns |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |
| Additional report/notes:   1. frequency offset 2. the branch number 3. antenna configuration for CDL model 4. any optional or other assumption/parameters used not as in the baseline | | | | |

Table 10. LLS template: SINR in dB achieving PRACH preamble misdetection probability of 1% with less than 0.1% false alarm

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-xxxxxxx / Source 1 | TDL-A, 5ns |  |  |  |  |
| TDL-A, 10ns |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |
| Additional report/notes:  1. PRACH format  2. values of  3. antenna configuration for CDL model  4. any optional or other assumption/parameters used not as in the baseline | | | | |

Companies are encouraged to provide comments if any.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| NTT DOCOMO | Support the templates above. |
| Intel | We are ok with moderator’s suggestion. For the PDSCH and PUSCH table, we think there could be value to also provide 1% SNR values, as just having 10% may not provide a full picture of the curvature of the BLER curves.  For each entry, we can have X, Y where X is for 10% and Y is for 1% BLER. |
| vivo | Support moderator’s proposal |
| InterDigital | We are fine with the template, but 20ns for TDL-A may be needed if we agree |

## 3.2. System Level Simulation

There’re several companies submitted their preliminary SLS evaluation results to this meeting. Due to different result presentations are used in the contributions to this meeting, it is hard to compile and collect all the submitted results. To facilitate collecting results into the TR for meaningful observations and conclusions, a template similar to what was used for NR-U SI/WI has been proposed for companies to use capturing SLS results for next meeting.

Proposal #10 for discussion:

* It is recommended to use the following template in Table 11 to capture SLS results.

Table 11. System level evaluation results for scenario

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1 | | | Case 2 | | |
| R1-xxxxxxx / Source 1 | Traffic load  Metrics | | Low load | Medium load | High load | Low load | Medium load | High load |
| DL UPT (Mbps) | 5%ile |  |  |  |  |  |  |
| 50%ile |  |  |  |  |  |  |
| 95%ile |  |  |  |  |  |  |
| mean |  |  |  |  |  |  |
| DL delay (s) | 5%ile |  |  |  |  |  |  |
| 50%ile |  |  |  |  |  |  |
| 95%ile |  |  |  |  |  |  |
| mean |  |  |  |  |  |  |
| UL UPT (Mbps) | 5%ile |  |  |  |  |  |  |
| 50%ile |  |  |  |  |  |  |
| 95%ile |  |  |  |  |  |  |
| mean |  |  |  |  |  |  |
| UL delay (s) | 5%ile |  |  |  |  |  |  |
| 50%ile |  |  |  |  |  |  |
| 95%ile |  |  |  |  |  |  |
| mean |  |  |  |  |  |  |
| Arrival rate (files/s) | |  |  |  |  |  |  |
| 𝜌DL | |  |  |  |  |  |  |
| BO | |  |  |  |  |  |  |
| RU | |  |  |  |  |  |  |
| Additional report/notes:  1. LBT procedure and parameters  2. any assumptions/parameters used not as in the agreed baseline | | | | | | | |

Companies are encouraged to provide comments if any.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| NTT DOCOMO | Support the templates above. |
| Intel | We are ok with moderator suggestion. Companies should provide detail information about the different cases being simulated (case 1 and 2 above).  In addition to above, we would like to also to provide RMS delay spread CDF figures, and corresponding ISI or INR figures. The SLS provides a lot of meaningful channel statistics that LLS cannot provide. We are not sure if a template is needed, but we should allow companies to provide such figures and have them captured in the TR as well. |
| vivo | Support moderator’s proposal |
| InterDigital | We are fine with the template. |

# Conclusion of the Discussion [102-e-NR-52-71-Evaluations]

**Summary of email discussion outcome:**

* TBD

# Reference

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