**3GPP TSG RAN WG1 Meeting #101-E R1-2004754**

**e-Meeting, May 25 – June 05, 2020**

**Source: Moderator (Intel Corporation)**

**Title: Summary of email discussions for [101-e-NR-52\_71\_GHz]**

**Agenda item: 8.1**

**Document for: Discussion**

# Introduction

In this contribution, we summarize the email discussion approved for discussion during RAN1 #101-E. Chairman has approved one email discussion thread for RAN1 #101-E for Agenda 8.1. The guidance was to focus on evaluation assumptions and if time allows (and feasible to conclude) to discuss high-level issues for NR 52.6 GHz to 71 GHz SI.

A summary of evaluation assumptions and simulation parameters from submitted contribution is available in R1-2004703 [1]. The following sections have been tagged with outline levels so that companies can easily search and move between tables and sections. Companies can go to ‘View’ panel of the Office Ribbon and select ‘Navigation Pane’ to show the outline bookmarks and click on specific outlines to go to the specific text or table.

# Email Discussion [101-e-NR-52\_71\_GHz]

It would be useful to categorize the discussion into three components, evaluation methodology for link level simulation, evaluation methodology for system level simulation, and high-level issues for supporting NR from 52.6 GHz to 71 GHz SI. The third topic, high-level issues, will be de-prioritized compared to the first two. The feature lead suggests to only aim for conclusion if wide support from numerous companies are available for specific issues.

## 2.1 Evaluation Methodology for Link Level Simulation

Moderator suggests identifying some of the evaluation objective (i.e. purpose) and related evaluation assumptions. Identification of the objective could be crucial to understand whether a single evaluation assumption is sufficient for all objectives or whether RAN1 needs to define multiple link level evaluation assumptions targeting different objective sets.

Based on contributions submitted, Moderator has identified the following evaluation objectives:

* Phase noise impact for various numerology (i.e. subcarrier spacing, and CP type)
* Performance analysis for PDSCH/PUSCH
* Performance analysis for SSB
* Channel delay spread impact for various CP type/lengths

Also put together a table for initiating discussions on the evaluation assumptions.

Table 1. Suggested harmonized link level simulation parameters as baseline for discussion

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Notes** |
| Carrier Frequency [GHz] | 60 GHzOptional: 70 GHz |  |
| Subcarrier Spacing [kHz] | 240 kHz, 480 kHz, 960 kHzOptional: 60 kHz, 120 kHz, 1920 kHz, 3840 kHz |  |
| Bandwidth [MHz] | 2000 MHzOptional: 400 MHz, 500 MHz |  |
| Number of RB | For 2000 MHz:320 (480 kHz), 160 (960 kHz), 80 (1920 kHz), 40 (3840 kHz)For 400 MHz:256 (120 kHz), 128 (240 kHz), 64 (480 kHz), 32 (960 kHz), 16 (1920 kHz), 8 (3840 kHz)For 500 MHz:330 (120 kHz), 165 (240 kHz), 82 (480 kHz), 41 (960 kHz), 20 (1920 kHz), 10 (3840 kHz) | Do not exceed 4k FFT size |
| CP Type | Normal CP, Extended CP |  |
| Channel Model | TDL-A (5ns, 10ns DS)Optional:TDL-D (1ns, 10ns DS)Optional:CDL-A (10ns, 30ns DS)CDL-B (10ns, 20ns, 50ns DS)CDL-D (20ns, 30ns, 40ns, 50ns DS) |  |
| Antenna Configuration (Mg,Ng,M,N,P) | For TDL model:2x2Optional: 1x2For CDL model:(1,1,8,16,2) BS, (1,1,4,4,2) UE with (0.5 dv, 0.5 dH)Optional BS configuration:(1,1,4,8,2), (2,2,4,8,2), (1,1,4,8,2)Optional UE configuration(1,1,2,4,2), (1,2,2,4,2), (1,1,2,2,2) |  |
| PA Model | Optional:Companies to provide modeling | In lieu of pre-loaded Tx EVM |
| Tx PN Model | 3GPP TR38.803 example 2 BSOptional:3GPP TR38.803 example 1Companies to provide modeling |  |
| Rx PN Model | 3GPP TR38.803 example 2 UEOptional:3GPP TR38.803 example 1Companies to provide modeling |  |
| Pre-loaded Tx EVM | Optional:3% at Tx | In lieu of PA model |
| Additive Rx EVM | Optional:5% at Rx |  |
| I-Q Imbalance | Optional:-26dBc, -31dBc |  |
| Channel Estimation | Realistic channel estimation |  |
| Mobility | 3 Km/hr |  |
| Transmission Rank | Rank 1Optional: Rank1+2 adaptive, Rank 2 |  |
| PDSCH SLIV | (S=2, L=12)Optional:(S=3, L=11), (S=0, L=14) | Starting symbol, S, (indexed from 0) and length, L. |
| DMRS Configuration | Front loaded, 1 DMRS symbolOptional:2 DMRS symbol at (2,11) symbol index |  |
| PTRS Configuration | (K = 4, L = 1)Optional:(K = 2, L = 1) | PTRS per K number of PRBs, and PTRS every L number of OFDM symbols |
| MCS/TBS | MCS 16 (16QAM), MCS 22 (64QAM)Optional:MCS 1 (QPSK), MCS 7 (QPSK),MCS 23 (256QAM), MCS 27 (256QAM) |  |
| Frequency Offset | Optional:0.1 ppm (for data channel)10 ppm (for initial access) |  |

**Discussion Summary:**

Companies are encouraged to provide comments on

* Evaluation objectives
	+ Including whether we should define a separate evaluation parameter set for a group of objective(s) separately or whether single set of evaluation parameters is sufficient.
* Comment on individual parameters, including whether anything is missing from the evaluation parameter set.
	+ Including whether or not to define ‘optional’ values or whether RAN1 should just simply provide a list of parameters without providing optionality.

Table 2. LLS Parameter Set 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter****Set 1** | **Evaluation Objectives** | **Carrier Frequency [GHz]** | **Subcarrier Spacing [kHz]** | **Bandwidth [MHz]** | **Number of RB** | **Waveform** |
| **Value** | Phase noise impact for various numerology (i.e. subcarrier spacing, and CP type)Performance analysis for PDSCH/PUSCHPerformance analysis for SSBChannel delay spread impact for various CP type/lengths | 60 GHz Optional: 70 GHz | 240 kHz, 480 kHz, 960 kHz Optional: 60 kHz, 120 kHz, 1920 kHz, 3840 kHz | 2000 MHz Optional: 400 MHz, 500 MHz | For 2000 MHz:320 (480 kHz), 160 (960 kHz), 80 (1920 kHz), 40 (3840 kHz) For 400 MHz:256 (120 kHz), 128 (240 kHz), 64 (480 kHz), 32 (960 kHz), 16 (1920 kHz), 8 (3840 kHz) For 500 MHz:330 (120 kHz), 165 (240 kHz), 82 (480 kHz), 41 (960 kHz), 20 (1920 kHz), 10 (3840 kHz) | CP-OFDMDFT-s-OFDM |
| **[Company Name here]** | [enter comments here] |  [enter comments here] | [enter comments here] | [enter comments here] |  [enter comments here] |  |
| **Huawei, HiSilicon** | Performance analysis should refer to quantifiable KPIs. So we suggest changing to BLER analysis for PDSCH/PUSCH. Is performance analysis for SSB about BLER of PBCH, or is the intention to look at other metrics such as detection probability or false alarm rate? We think that looking at the BLER is sufficient, and could be inferred from the BLER of PDSCH. Thus we think we may not need to add a KPI for evaluation of SSB. | It is not clear why evaluations at two nearby frequencies is needed. ITU-R selected 70 GHz for IMT-2020 evaluations, so we suggest 70 GHz as mandatory, and no need to provide optional values. | 120 kHz is the largest SCS already available in FR2, so it should be evaluated by companies and serve as a baseline.  | 2000 MHz is too large to evaluate using a single carrier with SCS smaller than 960kHz. If 2000 MHz is useful for SCS, we could use a smaller value for LLS, e.g. 400/ MHz. it is not clear why more than one value is needed. |  |  |
| **Lenovo /Motorola Mobility** | Obj1: Primary evaluation objective of the LLS should be see the impact of PN with normal cyclic prefix length with different SCS:* For this objective, BLER for PDSCH/PUSCH should be prioritized and SSB evaluation could be optional

Obj2: In addition, it is also important to study if and for what SCS, extended cyclic prefix will be needed.* For this objective, different ECP values should be evaluated at least for 960 kHz SCS and higher, if needed

Obj3: Optionally, the impact/necessity of different SCS values could be evaluated for different carrier frequencies i.e. if the same set of SCS values are needed for entire range of 52.6 GHz to 71 GHz | We agree to keep 60 GHz as the main candidate value for carrier frequency for Obj 1 and Obj2.For Obj 3, it could be useful to simulate additionally for ~50GHz and ~70GHz to see the variation with SCS across the entire range of carrier frequencies in this SI | We also have similar view has Huawei/HiSilicon to simulate 120 kHz as the baseline. We agree with other required SCS values i.e. 240 kHz, 480 kHz, 960 kHz.For Optional value, we think 1920 kHz could only be evaluated | We also agree with Huawei/HiSilicon. We think at least one value i.e. 400 MHz should be required to allow performance comparison without considering CA. 2000 MHz could be optional | As suggested 400 MHz as required value for BW size, the following # of RBs should be required corresponding to required SCS values as recommended by us:For 400 MHz:256 (120 kHz)128 (240 kHz)64 (480 kHz)32 (960 kHz)16 (1920 kHz) (optional) | We suggest keeping CP-OFDM as mandatory for evaluationsDFT-s-OFDM can be optional |
| **Ericsson** | A single set of evaluation objectives is sufficient as a starting point. The primary objectives of the link level evaluation are performance with phase noise impairment and effect of delay spread. |  |  | It is our view that it is too early for 3GPP to decide on 2000 MHz as the primary focus. We suggest giving equal priority to at least 3 candidate bandwidths, e.g., 500, 1000 and 2000 MHz BW evaluation to guide further discussion on selecting a combination of SCS and max BW. | We suggest replacing the 400 MHz list with a 1000 MHz list. We further suggest removing cases with fewer than 20 RBs (SSB BW) and simplifying the BW/PRB combinations (since exact guard band sizes are to be decided by RAN4).For 2000 MHz:320 (480 kHz), 160 (960 kHz), 80 (1920 kHz), 40 (3840 kHz)For 1000 MHz:320 (240 kHz), 160 (480 kHz), 80 (960 kHz), 40 (1920 kHz), 20 (3840 kHz)For 500 MHz:320 (120 kHz), 160 (240 kHz), 80 (480 kHz), 40 (960 kHz), 20 (1920 kHz) |  |
| **Futurewei** | Phase noise impact for various numerology (i.e. subcarrier spacing, and CP type)Performance analysis for SSB (with beamform)Channel delay spread impact for various CP type/lengthsPerformance analysis for PDSCH/PUSCH | 60 GHz as the main target, and optional 70GHz | 240 kHz, 480 kHz, 960 kHz Optional: 120 kHz (already supported in FR2) | 800 MHzOptional: 400 MHz, Optional: 1600 MHzLarger bandwidth such 2000 MHz can be obtained with CA  | 128 (480 kHz, 800 MHz),256 (240 kHz, 800 MHz)64 (960 kHz, 800 MHz) |  |
| **vivo** | Our understanding is that 1st, 2nd and 4th objective can be combined into one where PDSCH/PUSCH BLER performance with RF impairment and effect of delay spread is investigated.We also support the 3rd objective on the impact of SCS on SSB/initial access performance. | Support Moderator’s proposal | Support Moderator’s proposal | On bandwidth, if the intention is to see the impact of bandwidth, we suggest 500 MHz and 1 GHz in additional to 2 GHz. 400 MHz is so close to 500 MHz to see any difference. | Similar view as Ericsson to replace the 400 MHz list with a 1000 MHz list. For 2000 MHz:320 (480 kHz), 160 (960 kHz), 80 (1920 kHz), 40 (3840 kHz)For 1000 MHz:320 (240 kHz), 160 (480 kHz), 80 (960 kHz), 40 (1920 kHz), 20 (3840 kHz)For 500 MHz:320 (120 kHz), 160 (240 kHz), 80 (480 kHz), 40 (960 kHz), 20 (1920 kHz), 10 (3840 kHz) | We also support to evaluate PUSCH with DFT-s-OFDM as optional |

Table 3. LLS Parameter Set 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter****Set 2** | **CP Type** | **Channel Model** | **Antenna Configuration (Mg,Ng,M,N,P)** | **Mobility** |
| **Value** | Normal CP, Extended CP | TDL-A (5ns, 10ns DS) Optional:TDL-D (1ns, 10ns DS) Optional:CDL-A (10ns, 30ns DS)CDL-B (10ns, 20ns, 50ns DS)CDL-D (20ns, 30ns, 40ns, 50ns DS) | For TDL model:2x2Optional: 1x2For CDL model:(1,1,8,16,2) BS, (1,1,4,4,2) UE with (0.5 dv, 0.5 dH)Optional BS configuration:(1,1,4,8,2), (2,2,4,8,2), (1,1,4,8,2)Optional UE configuration(1,1,2,4,2), (1,2,2,4,2), (1,1,2,2,2) | 3 Km/hr |
| **[Company Name here]** |  [enter comments here] | [enter comments here] | [enter comments here] | [enter comments here] |
| **Huawei, HiSilicon** |  | We would propose CDL-D and CDL-B as mandatory because beam-based transmission is inevitable in this frequency range.  | For CDL, we would suggest making mandatory one of the BS configurations with fewer antennas, e.g. (1,1,4,8,2) for InH.For TDL with 2x2 link for rank 1 transmission, what would be the assumption on the precoding matrix for the link-level? |  |
| **Lenovo /Motorola Mobility** | NCP should be considered for all the SCS value and ECP should be considered for SCS value of at least 960 kHz and higher | CDL-B with 10ns, 30ns and 50ns DS and CDL-D with 20ns, 30ns, 50ns DS should be requiredCDL-A with 10ns and 30ns DS could be optional | We suggest having one required configuration i.e. BS (1,1,4,8,2) & UE (1,1,2,2,2) with (0.5dv, 0.5 dH) | We agree with 3Km/hr |
| **Ericsson** | We suggest NCP should be the baseline and ECP as optional. Please see further our comments on the MCS. | The TDL models are intended for simplified evaluations [38.901]. They are not suitable choices for the NR operations in 60 GHz study where the distributions of delay spreads and impacts of beamforming play utmost importance in the decisions of SCS selection and other essential system designs. We see two immediate flaws in the proposed TDL-A 5 or 10 ns DS models:We attached below comparisons of delay spread distributions before and after beamforming. It can be observed that the DS distribution after beamforming cannot be well approximated by using just one pre-BF DS distribution.Assuming very short DS of 5 or 10 ns does not match the actual DS after beamforming and underestimates the negative impact of inter-symbol interference. Using such short DS can lead to a SCS choice that performs poorly in a real deployment.Moreover, since beam forming is an inherent aspect in the evaluations, it is essential to model the spatial characteristics of the channel. The CDL model accounts for the angle spreads and mean angle of arrival/departure in both the azimuth and zenith dimensions. It is important to capture the interplay between these parameters and beamforming at the gNB and UE in order to provide post-beamformed channels with the proper characteristics. These characteristics, which are crucial to consider, can only be obtained using CDL channel; the TDL model does not account for these characteristics. Hence, TDL should not be the primary model used for evaluations.In conclusion, we suggest adopting the following way forward:CDL as the primary model and TDL as optional:CDL-B (20ns, 50ns DS)CDL-D (20ns, 30ns DS) The 20 ns delay spread is consistent with the indoor office environment (see comments in next column) and the {30,50} ns delay spread values correspond to the outdoor environment Optional:TDL-A (4ns, 8ns, 16ns, 32ns, 48ns, 64ns DS) | In our view, the assumption of (1,1,8,16,2) BS, (1,1,4,4,2) UE is not representative of indoor applications. We suggest adopting a framework that treats indoor and outdoor applications separately:(1,1,8,16,2) BS, (1,1,4,4,2) UE with (0.5 dv, 0.5 dH) for the UMi outdoor environmentCDL-B (50ns)CDL-D (30ns)(1,1,4,8,2) BS, (1,1,2,2,2) UE with (0.5 dv, 0.5 dH) for the indoor office environmentCDL-B (20ns)CDL-D (20ns) |  |
| **Futurewei** | Normal CP, Extended CP  | TDL-A (5ns,10ns DS)CDL-B (10ns, 20ns, 50ns DS) | For TDL model:2x2For CDL model:(1,1,8,16,2) BS, (1,1,4,4,2) UE with (0.5 dv, 0.5 dH) |   |
| **vivo** | Support NCP as mandatory and keep ECP to be optional for evaluation | Support Moderator’s proposal | OK with Moderator’s proposal This is for LLS. Don’t see the need to have antenna configurations targeting for outdoor and indoor scenario separately |   |

Table 4. LLS Parameter Set 3

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter Set 3** | **PA Model** | **Tx PN Model** | **Rx PN Model** | **Pre-loaded Tx EVM** | **Additive Rx EVM** | **I-Q Imbalance** | **Frequency Offset** |
| **Value** | Optional:Companies to provide modeling (in lieu of pre-loaded Tx EVM) | 3GPP TR38.803 example 2 BSOptional:3GPP TR38.803 example 1Companies to provide modeling | 3GPP TR38.803 example 2 UEOptional:3GPP TR38.803 example 1Companies to provide modeling | Optional:3% at Tx(In lieu of PA model) | Optional:5% at Rx | Optional:-26dBc, -31dBc | Optional:0.1 ppm (for data channel)10 ppm (for initial access) |
| **[Company Name here]** |  [enter comments here] | [enter comments here] | [enter comments here] | [enter comments here] | [enter comments here] | [enter comments here] | [enter comments here] |
| **Huawei, HiSilicon** |  |  |  | Pre-loaded EVM is simpler than aligning the PA models and parameters (e.g. back-off value) |  |  |  |
| **Lenovo /Motorola Mobility** | We suggest adding PA model, preferably with memory effect | We suggest PDSCH (Ex2 BS)PUSCH (Ex2 UE) | We suggest PDSCH (Ex2 UE)PUSCH (Ex2 BS) |  |  | We suggest adding the I-Q imbalance option |  |
| **Ericsson** |  | In R1-2003851, we raised the need to have a phase noise modeling that is more representative of integrated RF circuit solutions more suited for low cost unlicensed band / indoor operations. Example 2 BS model, being based on GaAs, may not be widely used for such applications. We suggest sending a LS to RAN4 to coordinate the phase noise modeling work for the SI. | In our Tdoc (R1-2003851), we also presented a new phase noise model based on recently published data on both state-of-the-art PLL and crystal oscillators that lead to an improved model representing the current technology envelope.We suggest sending a LS to RAN4 to coordinate the phase noise modeling work for the SI. |  |  |  |  |
|  **Futurewei** |  |  |  |  |  |  |  |
| **vivo** |  |  |  |  |  | We support to evaluate IQ-imbalance impact. On the listed parameter values, we think other values should be allowed as well. For example, in TS 38.101-2-f70, the requirement on FR2 is -25/-20 dBc for UE TX IQ image depends on UE output power and power class. Based on our understanding, the requirement will be more relaxed in 60GHz due to higher RF complexity. For determining the values here, we suggest sending an LS to RAN4 to get the reasonable values to facilitate the evaluation in RAN1. |  |

Table 5. LLS Parameter Set 4

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter Set 4** | **Channel Estimation** | **Transmission Rank** | **PDSCH SLIV** | **DMRS Configuration** | **PTRS Configuration** | **MCS/TBS** |
| **Value** | Realistic channel estimation | Rank 1Optional: Rank1+2 adaptive, Rank 2 | (S=2, L=12)Optional:(S=3, L=11), (S=0, L=14)Note: Starting symbol, S, (indexed from 0) and length, L. | Front loaded, 1 DMRS symbolOptional:2 DMRS symbol at (2,11) symbol index | (K = 4, L = 1)Optional:(K = 2, L = 1)Note: PTRS per K number of PRBs, and PTRS every L number of OFDM symbols | MCS 16 (16QAM), MCS 22 (64QAM)Optional:MCS 1 (QPSK), MCS 7 (QPSK),MCS 23 (256QAM), MCS 27 (256QAM) |
| **[Company Name here]** |  [enter comments here] | [enter comments here] | [enter comments here] | [enter comments here] | [enter comments here] | [enter comments here] |
| **Huawei, HiSilicon** |  | Do we really need the options? |  |  | Since 8 PRBs is the minimum number proposed in the evaluation assumptions, taking K=2 as mandatory would be more reasonable. | Which MCS table is used for each MCS? For example:MCS 16 (16QAM), MCS 22 (64QAM) – MCS index table 1 for PDSCHMCS 1 (QPSK), MCS 7 (QPSK) – MCS index table 1 for PDSCHMCS 23 (256QAM), MCS 27 (256QAM) – MCS index table 2 for PDSCHWhy are multiple MCS needed for 256QAM and for QPSK? |
| **Lenovo /Motorola Mobility** | We agree to have realistic channel estimation | We agree to have only Rank1 as mandatory | We suggest having S=0 and L=14 as mandatory.Optionally, we can have S=2, L=12 | We agree to have only front loaded, 1 DMRS symbol (with no data multiplexing on DM-RS symbol) | We propose to use the baseline PT-RS configuration as K=2, L=1 and K=4, L=1, depending up on RB allocationIn addition, companies should be encouraged to evaluate any new additional PT-RS configurations with relatively better performance | We suggest using 16QM, 64QM with moderate CR, e.g. from PDSCH table 1 MCS 16, MCS 22, 256QAM as an option, e.g. from PDSCH table 2 MCS27 |
| **Ericsson** |  |  |  |  | From the Moderator Summary R1-2004703, it appears that the majority of the companies evaluated using K=2 configuration. Perhaps, we can change the configuration to using K=2 to have accurate CPE estimation in most scenarios. | We assume these MCSs are for NCP. For ECP, we believe higher code rates should be used for a fair comparison to NCP. Let $L$ and $R\_{ncp} $denote the allocated # of OS and code rate for NCP, respectively. Assuming one DMRS OS, the code rate for ECP should be raised to $R\_{ecp}=\left(L-0.5\right) R\_{ncp}/(L-2.5)$. With this adjustment, a PDSCH carries the same number of info bits regardless of whether NCP or ECP is used.For the example of $L=12$, NCP MCS16 should be compared to ECP 16QAM $R\_{ecp}=796/1024$ or ECP MCS19 (64QAM). NCP MCS22 should be compared to ECP MCS25. |
| **Futurewei** | Start with ideal to calibrate, Then add realistic channel estimation | Rank 1  | (S=2, L=12) | 2 DMRS symbol at (2,11) symbol index Optional: Front loaded, 1 DMRS symbol | (K = 4, L = 1) | MCS 16 (16QAM), MCS 22 (64QAM) |
| **vivo** |  |  |  |  | K=2, L=1 and K=4, L=1 depending on RB number |  |

## 2.2 Evaluation Methodology for System Level Simulation

The submitted system level simulations were utilized to obtain analysis for the following purposes:

* Channel delay spread impact for various CP type/lengths
* NR-NR multi-operator coexistence analysis
* Performance analysis for PDSCH/PUSCH
* Performance impact for using various CCA levels and LBT schemes (e.g. receiver-aided LBT, omni-directional LBT, directional LBT, etc)

Table 6. Suggested harmonized system level simulation parameters as baseline for discussion

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Notes** |
| Carrier Frequency [GHz] | 60 GHzOptional: 70 GHz |  |
| Subcarrier Spacing [kHz] | 960 kHzOptional: 60 kHz, 120 kHz, 240 kHz, 480 kHz, 1920 kHz, 3840 kHz |  |
| Bandwidth [MHz] | 2160 MHzOptional: 500 MHz |  |
| Number of RB | For 2160 MHz:340 (480 kHz), 178 (960 kHz), 89 (1920 kHz), 44 (3840 kHz)For 500 MHz:330 (120 kHz), 165 (240 kHz), 82 (480 kHz), 41 (960 kHz), 20 (1920 kHz), 10 (3840 kHz) | Do not exceed 4k FFT size |
| Deployment Scenario | **Indoor Office:**Scenario 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 boxOptional:Scenario 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 boxOptional:Scenario 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 = 20mOptional:Scenario 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 = 40mOptional:Scenario 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=40mimage001**Dense Urban:**Scenario F) Dense Urban with 1 layerHexagonal grid, single layer, 3 sectors per site, 19 sites locations, BS height 10m, UE height 1.5m, ISD = 150mOptional:Scenario G) Dense Urban with 2 layersMacro layer (sub 7GHz):Hexagonal grid, single layer, 3 sectors per site, 19 sites locationsBS height 25m, UE height 1.5m, ISD = 200m, fixed BS positionMicro layer (above 52.6 GHz):BS height 10m, UE height 1.5m, 2 operator, 1 BS per hexgrid per operator, random position within macro hexagonal grid per operator, minimum distance between TRP and UE: 10m, **Indoor Factor Hall:**Optional:Indoor factory with Dense cluster & low BS (InF-DL)Grid, 300m x 150m x 10m factor hallISD 50m, BS height 1.5m, UE height 1.5m, Typical clutter size 2m, Clutter height 6m, Clutter density 20%Optional:Indoor factory with sparse clutter & High BS (InF-SH)Grid, 300m x 150m x 10m factor hallISD 50m, BS height 8m, UE height 1.5m, Typical clutter size 10m, Clutter height 2m, Clutter density 60% |  |
| UE distribution | Average of 10 UE per BSFor InH open office: 100% indoor UEsFor Dense urban: 100% outdoor UEsFor InF: 100% indoor UEs | UE randomly distributed over the entire deployment area |
| Channel Model | InH open office:InH – office channel & PL model from TR38.901Dense Urban:UMi street canyon channel & PL model from TR38.901Indoor factor:InF channel & PL model from TR38.901 |  |
| Mobility | 3 Km/hr |  |
| BS Antenna Configuration (Mg,Ng,M,N,P) | (1,1,8,16,2) with (0.5 dv, 0.5 dH)Optional:(1,1,4,4,2), (1,1,8,4,2), (1,1,8,8,2), (1,1,16,16,2), (1,1,32,8,2) |  |
| BS Antenna Pattern | Antenna power pattern given in Table 7.3-1 of TR38.901(with exception of antenna element gain) |  |
| BS Antenna element gain | 5 dBi |  |
| UE Antenna Configuration (Mg,Ng,M,N,P) | (1,1,2,4,2) with (0.5 dv, 0.5 dH)Optional:(1,1,1,2,2), (1,1,2,2,2), (1,1,4,4,2) |  |
| UE Antenna Pattern | Antenna power pattern given in Table 7.3-1 of TR38.901(with exception of antenna element gain) |  |
| UE Antenna element gain | 0 dBiOptional:5dBi |  |
| BS Power Limitation | 40 dBm EIRP Maximum TxP adjusted to meet EIRP limits |  |
| UE Power Limitation | 25 dBm EIRP with 21 dBm max TxPOptional:40dBm EIRP with 21 dBm max TxP |  |
| BS NF | 7 dB |  |
| UE NF | 13 dBOptional:10 dB |  |
| Transmission Rank | Rank adaptative transmission between Rank 1 and 2 |  |
| PDCCH Overhead | 2 Symbol per slot |  |
| DMRS Overhead | 1 Symbol per slot |  |
| CSI-RS Overhead | - |  |
| SRS Overhead | - |  |
| Other Overhead | - | This can include overhead from beam management, PRACH, RAR, SR, etc. |
| TDD DL/UL Ratio | - |  |
| CSI feedback | Ideal feedback |  |
| Additive Rx EVM | Optional:5% at Rx | In lieu of PA model, Tx/Rx PN Model, I-Q imbalance, and other RF impairments |
| Traffic Model | FTP Model 3 (0.5MByte file)Optional: Full buffer,FTP Model 1 (27Mbyte file)FTP Model 3 (27Mbyte file) |  |
| UE Receiver | MMSE-IRC |  |
| Cell selection criteria | Random select from strongest RSRP with 1 dB HO Marginhysterisys |  |
| DL/UL Traffic Ratio | 50% DL, 50% ULOptional:100% DL, 0% UL,80% DL, 20% UL0% DL, 100% UL |  |

**Discussion Summary:**

Companies are encouraged to provide comments on

* Evaluation objectives
	+ Including whether we should define a separate evaluation parameter set for a group of objective(s) separately or whether single set of evaluation parameters is sufficient.
* Comment on individual parameters, including whether anything is missing from the evaluation parameter set.
	+ Including whether or not to define ‘optional’ values or whether RAN1 should just simply provide a list of parameters without providing optionality.

Table 7. SLS Parameter Set 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter Set 1** | **Evaluation Objectives** | **Carrier Frequency [GHz]** | **Subcarrier Spacing [kHz]** | **Bandwidth [MHz]** | **Number of RB** |
| **Value** | Channel delay spread impact for various CP type/lengthsNR-NR multi-operator coexistence analysisPerformance analysis for PDSCH/PUSCHPerformance impact for using various CCA levels and LBT schemes (e.g. receiver-aided LBT, omni-directional LBT, directional LBT, etc) | 60 GHz Optional: 70 GHz | 960 kHz Optional: 60 kHz, 120 kHz, 240 kHz, 480 kHz, 1920 kHz, 3840 kHz | 2160 MHz Optional: 500 MHz | For 2160 MHz:340 (480 kHz), 178 (960 kHz), 89 (1920 kHz), 44 (3840 kHz) For 500 MHz:330 (120 kHz), 165 (240 kHz), 82 (480 kHz), 41 (960 kHz), 20 (1920 kHz), 10 (3840 kHz) |
| **[Company Name here]** |  [enter comments here] | [enter comments here] | [enter comments here] |  [enter comments here] | [enter comments here] |
| **Huawei, HiSilicon** | The objectives are generally fine, but we assume the goal is not to document values of RMS delay spread obtained by SLS since CP selection is expected to be based on LLS. SLS should rather look at the overall impact on system-level performance (throughput). So could we instead define the KPIs that are expected to be provided by the SLS? | It is not clear why evaluations at two nearby frequencies is needed. ITU-R selected 70 GHz for IMT-2020 evaluations, so we suggest 70 GHz as mandatory, and no need to provide optional values. | The SCS depends on the BW to be simulated. 120k/240Hz SCS for 500MHz and 960kHz for 2GHz | 2160MHz is not a typical 3GPP bandwidth. To align with LLS bandwidth, 2GHz can be considered.  |  |
| **Lenovo /Motorola Mobility** | We agree with Huawei. We should focus on the coexistence analysis e.g. NR-NR multi-operator, and the different LBT schemes and their impact on throughput/capacity. | We agree with 60 GHz as mandatory and 70 GHz as optional | We agree with 960 kHz as mandatory and 120 kHz, 240 kHz, 480 kHz, 1920 kHz as optional | We have similar views as Huawei/HiSilicon | Similar views as for LLS |
| **Ericsson** | Traditionally, we have used system throughput to evaluate the performance. In that sense we agree with HW. F**irst and third objective should be removed**. **Related to second and forth objective:**At this early stay, the SI should focus on studying the interference profile that is expected to be seen in these deployments (specially the indoor scenario), to be able to decide if interference mitigation techniques are needed. We should keep in mind that for such high frequency range many single operator use cases are expected (indoor office, factory, smart Home, etc...) this scenario should not be undermined.It is also worth noting that the multi-operator scenario is a worst-case scenario where both operators use the same channel, even though in reality the channel can be changed when interference is constantly observed. The multi-operator scenario can be justified in 5GHz, since a single channel is only 20MHz, and the assumption of operating on multiple channel to increase the capacity is reasonable. Hence, it is probable to coexist with other networks that are operating on the same channel. But the situation is different for 60GHz, where one channel can be up to 2.16 GHz. the UE device is of course power limited. The propagation loss is high, and number of available channels is also high. so in case of significant interference, the operating channel can be simply changed, so that the performance of the edge UEs can be improved. Nonetheless, we would be Ok with considering it, but only as a second stage. The focus for the first stage should be optimizing for the single operator scenario. **Related to fourth proposal:** Instead of jumping into solutions, we need to agree on the existence of a problem. So instead of studying enhancements for LBT, the objective should be to evaluate the interference impact on performance and coexistence between nodes. Based on the observations, the need for enhanced channel access mechanism and interference mitigation techniques can be studied (e.g. directional LBT, receiver assisted LBT)  |  | 960 kHz for indoor480 kHz for outdoor | 2000 MHz for indoor500 MHz for outdoor | For 2000 MHz: 160 (960 kHz)For 500 MHz: 80 (480 kHz) |
| **Futurewei** | NR-NR multi-operator coexistence analysisPerformance impact for using various CCA levels and LBT schemes (e.g. receiver-aided LBT, omni-directional LBT, directional LBT, etc). Evaluate no-LBT scheme.Channel delay spread impact for various CP type/lengthsPerformance analysis for PDSCH/PUSCH | 60 GHz,Optional: 70 GHz | 240 kHz, 480 kHz and 960 kHz | 800 MHz Optional: 400 MHz , we think that larger bandwith (2000 MHz) can be obtain via CA | 256 (240 kHz, 800MHz)128 (480 kHz, 800 MHz)64 (960 kHz, 800 MHz) |
| **vivo** | Our understanding is that Channel delay spread impact for various CP type/lengths on PDSCH/PUSCH performance has already been covered in LLS already. So no need to repeat here in SLS.We propose to focus the SLS on NR-NR multi-operator coexistence study including single-operator scenario for comparison. |  |  | 2000 MHz instead of 2160 MHz to be consistent with that in LLSOptional: 500 MHz | Consistent with that in LLS |

Table 8. SLS Parameter Set 2

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter Set 2** | **Deployment Scenario** | **UE distribution** | **Channel Model** |
| **Value** | **Indoor Office:**Scenario 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 boxOptional:Scenario 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 boxOptional:Scenario 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 = 20mOptional:Scenario 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 = 40mOptional:Scenario 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=40mimage001**Dense Urban:**Scenario F) Dense Urban with 1 layerHexagonal grid, single layer, 3 sectors per site, 19 sites locations, BS height 10m, UE height 1.5m, ISD = 150mOptional:Scenario G) Dense Urban with 2 layersMacro layer (sub 7GHz):Hexagonal grid, single layer, 3 sectors per site, 19 sites locationsBS height 25m, UE height 1.5m, ISD = 200m, fixed BS positionMicro layer (above 52.6 GHz):BS height 10m, UE height 1.5m, 2 operator, 1 BS per hexgrid per operator, random position within macro hexagonal grid per operator, minimum distance between TRP and UE: 10m, **Indoor Factor Hall:**Optional:Indoor factory with Dense cluster & low BS (InF-DL)Grid, 300m x 150m x 10m factor hallISD 50m, BS height 1.5m, UE height 1.5m, Typical clutter size 2m, Clutter height 6m, Clutter density 20%Optional:Indoor factory with sparse clutter & High BS (InF-SH)Grid, 300m x 150m x 10m factor hallISD 50m, BS height 8m, UE height 1.5m, Typical clutter size 10m, Clutter height 2m, Clutter density 60% | Average of 10 UE per BS For InH open office: 100% indoor UEsFor Dense urban: 100% outdoor UEsFor InF: 100% indoor UEs | InH open office:InH – office channel & PL model from TR38.901 Dense Urban:UMi street canyon channel & PL model from TR38.901 Indoor factor:InF channel & PL model from TR38.901 |
| **[Company Name here]** | [enter comments here] |  [enter comments here] | [enter comments here] |
| **Huawei, HiSilicon** | We suggest to shorten the office box size to 50\*50 with four office boxes, to reduce the simulation burden. For outdoor scenario, 7 sites could be sufficient (instead of 19) considering the higher pathlossWe would like to prioritize the indoor scenario. The ISD for outdoor scenario should be checked considering the transmit power and pathloss in the frequency band. . |  |  |
| **Lenovo /Motorola Mobility** | We prioritize indoor scenario, Scenario (A) | We suggest an average of 20 UEs/BS | InH – office channel & PL model from TR38.901InF channel & PL model from TR38.901 |
| **Ericsson** | We prefer to focus on a single indoor and single outdoor scenario and remove all the optionality that will only cause confusions. It is important that the indoor scenario has two setups, one with single operator (used in first stage), and 2 operators (used in the second stage). Stage 1: can be a smaller version of the 3rd layout that we proposed (50x60, with 6 gNBs)Stage 2: an extension of the same scenario but with 2 operators deployed similar to the 1st layout here. Outdoor scenario should be optional, and with much fewer number of gNBs as compared to scenario F.  | Baseline 5 UEs/gNB.Optional 10 UEs |  |
| **Futurewei** | Indoor Office Scenario A, Dense Urban Scenario G (one of each indoor/outdoor scenarios) | 10 UE per gNB, 100% indoor, 100% outdoor | InH open office:InH – office channel & PL model from TR38.901 Dense Urban:UMi street canyon channel & PL model from TR38.901  |
| **vivo** | Propose to prioritize indoor scenario for SLSFor Indoor Office, prefer Scenario AFor Dense Urban, prefer Scenario G. Note that our proposal in R1-2003425 has a scale factor to ISD which is not reflected in scenario G option. |  |  |

Table 9. SLS Parameter Set 3

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter Set 3** | **Mobility** | **BS Antenna Configuration (Mg,Ng,M,N,P)** | **BS Antenna Pattern** | **BS Antenna element gain** | **UE Antenna Configuration (Mg,Ng,M,N,P)** | **UE Antenna Pattern** | **UE Antenna element gain** |
| **Value** | 3 Km/hr | (1,1,8,16,2) with (0.5 dv, 0.5 dH) Optional:(1,1,4,4,2), (1,1,8,4,2), (1,1,8,8,2), (1,1,16,16,2), (1,1,32,8,2) | Antenna power pattern given in Table 7.3-1 of TR38.901(with exception of antenna element gain) | 5 dBi | (1,1,2,4,2) with (0.5 dv, 0.5 dH) Optional:(1,1,1,2,2), (1,1,2,2,2), (1,1,4,4,2) | Antenna power pattern given in Table 7.3-1 of TR38.901(with exception of antenna element gain) | 0 dBi Optional:5dBi |
| **[Company Name here]** | [enter comments here] |  [enter comments here] | [enter comments here] | [enter comments here] |  [enter comments here] | [enter comments here] | [enter comments here] |
| **Huawei, HiSilicon** |  | We would prefer reducing the number of optional configurations, e.g. to (1,1,4,4,2), or to have both (1,1,8,16,2) and (1,1,4,4,2) as mandatory, and leave the other configurations as optional. |  |  |  |  |  |
| **Lenovo /Motorola Mobility** | We agree with 3Km/hr | Similar configuration as for LLS |  |  | Similar configuration as for LLS |  |  |
| **Ericsson** |  | (1,1,8,16,2) for outdoor (1,1,4,8,2) for the indoor office  | According to 38.802, the 3db = 65 is suitable for single sector and 3-sector indoor deployment. Instead, for the Ceiling-mount 3db = 135 is used. [see 38.802 Table A.2.1-7: Indoor BS antenna radiation pattern for above 6GHz] ,  |  |  (1,1,4,4,2) for outdoor  (1,1,2,2,2) for the indoor office  | For 0 dBi UE AE gain, use omni-directional pattern.For >0 dBi UE AE gains, 38.802 proposes a UE antenna radiation pattern in Table A.2.1-8, so no need to use the one specified for the BS in 38.901. |  |
| **Futurewei** |   | (1,1,8,16,2) with (0.5 dv, 0.5 dH) |   |   | (1,1,4,4,2) with (0.5 dv, 0.5 dH) Optional: (1,1,2,2,2) |  |  |
| **vivo** |  |  |  |  | (1,1,4,4,2) with (0.5 dv, 0.5 dH) |  |  |

Table 10. SLS Parameter Set 4

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter Set 4** | **BS Power Limitation** | **UE Power Limitation** | **BS NF** | **UE NF** | **Transmission Rank** |
| **Value** | 40 dBm EIRP Maximum TxP adjusted to meet EIRP limits | 25 dBm EIRP with 21 dBm max TxP Optional:40dBm EIRP with 21 dBm max TxP | 7 dB | 13 dB Optional:10 dB | Rank adaptative transmission between Rank 1 and 2 |
| **[Company Name here]** |  [enter comments here] | [enter comments here] | [enter comments here] |  [enter comments here] | [enter comments here] |
| **Huawei, HiSilicon** |  |  |  |  |  |
| **Lenovo /Motorola Mobility** | Maximum TxP adjusted to meet EIRP limits |  |  |  | Agree |
| **Ericsson** |  |  |  |  |  |
| **Futurewei** |  40 dBm EIRP |   |  | 10 dB (consistent with RAN4 param for FR2) | Rank 1  |
| **vivo** |  |  |  |  |  |

Table 11. SLS Parameter Set 5

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter Set 5** | **PDCCH Overhead** | **DMRS Overhead** | **CSI-RS Overhead** | **SRS Overhead** | **Other Overhead** |
| **Value** | 2 Symbol per slot | 1 Symbol per slot | - | - | - |
| **[Company Name here]** | [enter comments here] |  [enter comments here] | [enter comments here] | [enter comments here] |  [enter comments here] |
| **Huawei, HiSilicon** |  |  |  |  |  |
| **Lenovo/****MotorolaMobility** | We agree to consider 2 symbols/slot as PDCCH overhead | We agree to consider 1symbols/slot as PDCCH overhead (with no data multiplexing on DM-RS symbol) |  |  |  |
| **Ericsson** |  |  |  |  |  |
| **Futurewei** |  |  |  |  |  |
| **vivo** |  |  |  |  |  |

Table 12. 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** |
| **Value** | - | Ideal feedback | - | FTP Model 3 (0.5MByte file) Optional: Full buffer,FTP Model 1 (27Mbyte file)FTP Model 3 (27Mbyte file) | MMSE-IRC | Random select from strongest RSRP with 1 dB HO Margin | 50% DL, 50% UL Optional:100% DL, 0% UL,80% DL, 20% UL0% DL, 100% UL |
| **[Company Name here]** | [enter comments here] | [enter comments here] |  [enter comments here] | [enter comments here] | [enter comments here] |  [enter comments here] | [enter comments here] |
| **Huawei, HiSilicon** | Irrelevant for unlicensed operation coexistence study  |  |  |  |  |  |  |
| **Lenovo/****Motorola Mobility** |  | Agree |  | Agree | Agree |  | Agree |
| **Ericsson**  |  |  |  | Full buffer should be removed.  |  | A lower limit on the received Power should be set. | The UE processing delays for 960KHz SCS are not specified. How should that be considered if UL is to be included at this early stage ?  |
| **Futurewei** |  | Ideal feedback |  | We prefer large files. FTP Model 1 (27 MB) |   |   | 80% DL, 20%ULOptional: 50% DL 50% UL |
| **vivo** |  |  |  |  |  |  |  |

Additional paramters to be reported:

Companies should provide LBT parameter details (ED, CWmax, COT, etc..) if LBT procedure is used.

## 2.3 High-level Issues for Supporting NR from 52.6 GHz to 71 GHz SI

Based on submitted contributions, we provide a summary of high-level abstracted issues for supporting NR from 52.6 GHz to 71 GHz. Please note the summary is not an exhaustive list.

1. Candidate numerology (SCS, and CP length) to be supported by RAN1 specification.
	* Discussions may include how RAN1 should conclude on determination of the candidate numerologies
	* Discussion may also include identification of any coupling with other system parameters, such as bandwidth (number of PRB), FFT size, etc
2. Candidate bandwidths (or range of bandwidth) to be supported by RAN1 specification and related considerations (e.g. maximum FFT size)
	* Discussions may include how RAN1 should conclude on determination of the candidate bandwidths
3. Identification of regulatory aspects to consider in channel access (and interference mitigation techniques) for 60GHz unlicensed NR operation
	* Some examples could be CCA sensitivity levels, time unit for measurement and back-off counters, access categories, channel bandwidth occupancy, etc.
4. Supported LBT modes of operation (e.g. omni-directional LBT, directional LBT, receiver-aided LBT, no-LBT, etc)
	* Discussion may include how RAN1 should conclude on LBT mode of operations and identification of various consideration aspects (in the decision-making process)
	* Discussions may also include whether to always mandate LBT operations or not

Other issues discussed in submitted contributions are (not an exhaustive list):

* Investigation of directional LBT
* Investigation of receiver-aided LBT
* Shared COT mechanisms
* Beam sweeping issues for SS/PBCH blocks
* Beam failure detection issues
* Potential enhancements to increase the channel access opportunities
* Energy detection threshold calculation to account for instance for the directivity of LBT, or LBT channel bandwidth
* OCB constraints and related specification impact
* FBE operations
* SSB and CORESET#0 multiplexing

**Discussion Summary:**

Companies are encouraged to provide comments on

* Identification of high-level issues/considerations
	+ Including whether the above listed 4 issues above is ok
	+ Including any changes and modifications to the high-level issue description
* For each high-level issue/consideration provide further comment on what RAN1 should make conclusions and agreements on.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| **Huawei, HiSilicon** | We suggest completing the list of other issues or considerations in making decisions on numerology and in assessing impact on channel design, to make it an exhaustive list. We noted at least the following points should be added: * Investigation of directional LBT
* Investigation of receiver-aided LBT
* Shared COT mechanisms
* Beam sweeping issues for SS/PBCH blocks (including beam switching time)
* Beam failure detection issues
* Potential enhancements to increase the channel access opportunities
* Energy detection threshold calculation to account for instance for the directivity of LBT, or LBT channel bandwidth
* OCB constraints and related specification impact
* PSD constraints and related specification impact
* FBE operations
* SSB and CORESET#0 multiplexing
* Constraints related to UE processing times and PDCCH monitoring capabilities
* Coverage requirements for IAB and for short physical channels
 |
| **Lenovo/****Motorola Mobility** | In addition to the key objectives listed in simulation assumptions i.e. **higher numerology with different CP lengths and new PT-RS configurations**, at least following issues should be considered and studied in this study item:* **For unlicensed access:**
	+ Investigation of directional LBT (including received assisted LBT)
	+ Shared COT mechanisms
	+ UL interlacing enhancements
	+ Initial access enhancements
* **For licensed as well as unlicensed access:**
	+ CSI processing timeline and CSI processing unit availability for different SCS
	+ PDCCH monitoring enhancements
	+ Scheduling enhancements for high SCS
	+ Beam managements enhancements, if needed
	+ New DM-RS design
 |
| **Ericsson** | The fourth proposal needs to be modified. It assumes that operation based on LBT as a channel access/interference mitigation technique is the baseline, when the SI description does not explicitly mention LBT. Ofcourse based on some regulations, it has to be there, but that discussion can be taken as part of the third proposal in the list. We propose to reword the fourth proposal to say supported channel access/interference mitigation techniques (e.g. ATPC, LBT, etc.. ) instead of LBT supported modes. |
| Futurewei  | We agree with high level issues 1) to 4), in addition we propose to investigate LBT specific beam management enhancements (for instance beam management for LBT failure) |
| vivo  | Support these 4 bullets as high level issues in principle. We have a similar view as Ericsson and also propose to reword the 4th main bullet into “Supported channel access/interference mitigation techniques (e.g. omni-directional LBT, directional LBT, receiver-aided LBT, no-LBT, etc.)”. Furthermore, we suggest to reword the 1st sub-bullet of the 4th bullet as well into “Discussion may include how RAN1 should conclude on channel access schemes and identification of various consideration aspects (in the decision-making process)” |

# Conclusion of the Email Discussion [101-e-NR-52\_71\_GHz]

**Summary of email discussion outcome:**

* xxx

# Reference

1. R1-2004703, “Summary of discussions on supporting NR from 52.6 GHz to 71 GHz,” Moderator (Intel Corporation)