**Proposal 13:**

* Adopt the following target data rates for eMBB performance evaluation for FR2.

- Indoor: DL: 25Mbps, [100Mbps], UL:5Mbps, [10Mbps]

- Urban: DL: 25Mbps, [100Mbps], UL: 5Mbps, [10Mbps]

- Suburban: DL: 1Mbps, UL: 50kbps, [200kbps]

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| **Companies** | **Comments** |
| Ericsson | We think 400 MHz system bandwidth should be used, since higher bandwidths are a primary advantage of FR2. Therefore, 100 Mbps is more suitable than 25 Mbps.  We suggest:  - Indoor: DL: 100Mbps, [25Mbps] UL: 10Mbps, [5Mbps]  - Urban: DL: 100Mbps, [25Mbps] UL: 10Mbps, [5Mbps] |
| Intel | We are fine to confirm the target data rate as indicated in the SID. |
| Huawei, HiSilicon | Support |
| **Sony** | Support the proposals |
| InterDigital | Support to confirm the values in SID |
| vivo | We agree with the values without brackets.  Besides, the target ISD for suburban need to be clarified. And the pathloss model, shadow fading margin seems not provided in ITU self-evaluation, further clarification is needed for these values for suburban scenario. |
| ZTE | We support to confirm the values in SID. |
| Nokia/NSB | It is too early to extend the target data rates at this stage. The target data rates in SID should be confirmed for evaluation first. Otherwise what is the point of having discussed and agreed on those values in the first place. Of course, any other values for target data rates of respective scenarios can be further discussed when evaluation results are available in next meeting, should RAN1 observe that the initial targets were too conservative. |
| Qualcomm | Support |
| CATT | We are OK to confirm the target data rate.  We also share the same views as vivo that further clarifications are needed for suburban scenario. |
| Samsung | We are fine with the proposal based on SID. |
| Apple | We are fine with proposal, just want to clarify the data rate in bracket is optional, right? |

**Proposal 14:**

* For link level simulation, TBS of VoIP for FR2 is the same as FR1.
* For link level simulation, TBS of Msg3 for FR2 is the same as FR1.

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| **Companies** | **Comments** |
| Ericsson | Agree with the proposal. |
| Intel | We are fine with the proposal. |
| Huawei, HiSilicon | Support |
| InterDigital | We are fine with the proposal for VoIP |
| vivo | We agree with the proposal. |
| ZTE | Support |
| Nokia/NSB | Agree with the proposal |
| Qualcomm | Support for VoIP. But about Msg3, we need clear and reasonable assumptions on the number of SSB beams (or the beam gain difference between unicast and broadcast) which is very important for the performance of Msg3. |
| CATT | Support |
| Samsung | We are fine with the proposal. |
| Apple | Agree with the proposal |

**Proposal 15:**

* The evaluation methodology for FR2 is the same as FR1.
* The link budget template for FR2 is the same as FR1.
* The target performance metric for FR2 is the same as FR1.

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| **Companies** | **Comments** |
| Ericsson | We think it is even more important for FR2 to have proper antenna gain modelling. Can we agree to the following:   * + Link budget evaluation methodology and template for FR2 include isotropic loss (a.k.a ‘Hardware link budget’)   + With the possible exception of the above, link budget evaluation methodology and template are the same as FR1.   We prefer to further discussed the need for a target metric and how such a metric would be quantified. A target metric is not needed if relative performance is used to identify bottleneck channels. |
| Intel | We are generally fine with the proposal. Target performance metric for FR2 may need further discussion, which depends on the decision in FR1. |
| Huawei, HiSilicon | Support |
| **Sony** | We agree with Ericsson that the antenna gain needs to be properly modelled, especially for UE side. We would like to reiterate our views here: inclusion of spherical coverage will influence the UE antenna gain. Simulations of spatial properties will give a gain distribution that includes both gain variations and the associated polarization properties. We propose that as an alternative to a fixed antenna gain, the X-th percentile derived from dropping a UE with a random orientation in the channel is used in the link budget.  In addition, as polarization properties are more prominent in FR2, it would be good if companies could agree on an assumption regarding polarization of the SSBs, e.g. SSBs are assumed vertically polarized. |
| vivo | We agree with the proposal. |
| ZTE | Support |
| Nokia/NSB | Similar to Ericsson, we also think a target metric may not be needed if relative performance is used to identify bottleneck channels. The concept of bottleneck is relative to a reference value, by definition. If such value is an independent target, then whatever falls short of it could be labelled a bottleneck. We think this may lead to wrong conclusions. We also would like to propose to agree on how BF and array gain are calculated for FR2. This aspect is even more relevant for FR2 then what we have for FR1. |
| Qualcomm | Agree with Ericsson. Also, it is better to consider EIRP limits rather than maximum Tx power (for gNB and UE). |
| CATT | Support |
| Samsung | We agree with the proposal. However, we have concerns about the relative performance to identify the target channels for coverage enhancement. In terms of the relative performance, we need to further discuss how to decide the bottleneck, i.e., reference channel or link budget value for reference, e.g., with maximum link budget or average link budget over the channels what we evaluated (just for example). After obtaining the baseline coverage performance, deciding the reference can be diverged if there is no clarification of bottleneck. |
| Apple | Support |

**Proposal 16:**

* For link level simulation, adopt the following table for PUSCH and PDSCH for FR2.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Scenario and frequency | 28GHz |
| Frame structure for TDD | DDDSU (S: 10D:2G:2U)  DDSU (S: 11D:3G:0U) |
| Subcarrier Space | 120kHz |
| BLER | 10% iBLER for eMBB, 2% rBLER for VoIP |
| UE velocity | Indoor scenario:3km/h  Urban scenario: 3km/h for indoor, 30km/h for outdoor.  Suburban scenario: 3km/h for indoor, 30km/h, [120km/h] for outdoor. |
| Occupied channel bandwidth for PDSCH | 100MHz, [400MHz] |
| Frequency hopping for PUSCH | Intra-slot, [inter-slot] frequency hopping is enabled |

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| --- | --- |
| **Companies** | **Comments** |
| Ericsson | We think 30 GHz should be used, as this is in line with prior evaluations.  HARQ should be explicitly simulated for PUSCH with [2%] rBLER.  3 kmph should be emphasized. Need to check on 120km/h.  System bandwidth should be 400 MHz, [100 MHz], as commented above given the greater bandwidth available for FR2.  The definition of the scenarios should be clarified; details are in appendix of the [FR2 email discussion document](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Inbox/drafts/8.4.1.2%20FR2/R1-20xxxxx%20-%20%5B101-e-NR-Cov-Enh%5D-FR2-v013-IDC-CMCC.docx). ITU InH\_B and UMa\_B can be used as scenarios.  Similar to FR1, simulations may or may not use frequency hopping, since it is not always beneficial. Companies can report whether it is used. |
| NTT DOCOMO | We also support 400 MHz system bandwidth which is the maximum bandwidth for FR2. |
| **Intel** | We suggest to remove the [120km/h] for outdoor. We are fine with 100MHz as system bandwidth.  For PDSCH, suggest to change frequency hopping to “localized/distributed mapping” |
| Huawei, HiSilicon | Frequency hopping should be up to company’s report, similar as the discussions for FR1  3km/h is more suitable for FR2 coverage evaluations and thus should be prioritized. With limited benefit and increased workloads, 30km/h should be optional. 120km/h can be removed.  We prefer 100MHz over 400MHz taking simulation times into consideration. |
| Sony | We support the proposals. We also agree with Ericsson and think that 400 MHz bandwidth is more relevant for FR2. |
| InterDigital | We support to use inter-slot FH. We are ok with the values. For evaluation of VoIP, feasible round trip for VoIP time may need to be agreed since round trip time will be much shorter at SCS=120kHz, compared to FR1. |
| vivo | For UE velocity, we prefer to narrow down to one option to reduce the work load, e.g. 30km/h. |
| ZTE | We support the proposal. |
| Nokia/NSB | We also think only one UE speed should be considered above 3 Km/h. 30 Km/h seems a reasonable candidate to us and 120 Km/h can be removed.  Intra-slot frequency hopping should be enabled. Inter-slot can be [optional].  We are fine with no retransmission for eMBB, i.e., target BLER should be 10% iBLER. Any effect of retransmissions should be modelled statically in the LB study (values can be discussed, either way it is an offset…).  Some companies seem to have issues with 400 MHz BW. Would 200 MHz be an agreeable solution to consider a configuration larger than 100 MHz but less computationally heavy than 400 MHz?  Finally, and as discussed in the FL summary for FR2, we observe that an “UL-heavy” frame structure is still missing from the list of considered frame structures. This choice is very questionable, given the impact it can have on the coverage. NR supports a high level of flexibility in this sense and we think it should be considered. This flexibility is even more important at FR2 than at FR1. In the very worst case, it should be considered at least as a benchmark, and not an optional parameter. Therefore, we propose to add 3D1S6U (10D:2G:2U) in the list of considered frame structures for evaluation in FR2. We are open to consider other frame structures if 3D1S6U is not agreeable. |
| Qualcomm | Support |
| CATT | We are generally OK with the proposal.  The bandwidth used for PUSCH should also be included. We agree with HW that it may be better to focus on 100MHz. |
| Samsung | We are fine with 100MHz for system bandwidth. In terms of coverage, larger BW may be not helpful with low data rate. We support 120km/h for outdoor to identify the effect of the high mobility in FR2. |
| Apple | In general, the proposal is fine, except the speed of 120km/h can be removed. |

**Proposal 17:**

* For link level simulation, adopt the following table for PUSCH and PDSCH for FR2.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| BLER | 10% iBLER for eMBB, 2% rBLER for voice. |
| Number of UE antennas | 8 |
| Number of UE TRXUs | 1 or 2 for PUSCH, 2 for PDSCH |
| DMRS configuration | For 3km/h: Type I, one DMRS symbol, no multiplexing with data.  For 30km/h, 120km/h: Type I, 2 or 3 DMRS symbol, no multiplexing with data. |
| Waveform | DFT-s-OFDM for PUSCH, CP-OFDM for PDSCH |
| Number of repetitions for PUSCH | For eMBB, no repetition is assumed.  For VoIP, the maximum number of repetitions can be 2/4/8. |
| HARQ configuration for PUSCH | For eMBB, no retransmission is assumed.  For VoIP, the maximum number of HARQ transmission can be 2/4/8. |

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| **Companies** | **Comments** |
| Ericsson | HARQ should be explicitly simulated for PUSCH with [2%] rBLER.  UE antenna configuration should be clarified: how many panels are used; what is the number of panels, etc. We think one good configuration is: 1T2R, [2T2R]; (M,N,P) = (4,2,2); 2 panels in different directions  Repetition and HARQ should be allowed for eMBB. |
| Intel | Similar to FR1, we suggest to at least align some of the parameters for TBS/MCS/number of PRBs for meaningful coverage study for FR2.  We suggest to remove 120km/h speed for FR2. |
| Huawei, HiSilicon | 3km/h is more suitable for FR2 coverage evaluations and thus should be prioritized. With limited benefit and increased workloads, 30km/h should be optional. 120km/h can be removed.  Number of repetition can be further narrowed down.  According to SID, VoIP for FR2 is second priority. Therefore, the part of VoIP should be removed at this stage or be optional. |
| **Sony** | We agree with Ericsson that the number of UE antennas and the orientation of the antenna panels need to be clarified. Two panels with different orientations is a reasonable assumption. In addition, 4 panels with different orientations can also be studied e.g. (Mg, Ng, M, N,P) = (1,4,1,4,2) according to Config2d or Config 2e, from table A.2.1-4 in TR38.802. |
| InterDigital | We are fine to allow HARQ and repetitions for eMBB. We agree that the (M,N,P) definition should be used. |
| vivo | Same as in FR1, we prefer HARQ is not assumed for voip, when repetition is considered.  For UE speed, we agree with intel, 120km/h is not preferred. |
| ZTE | The antenna configuration needs further clarification. (2, 2, 2, 1, 1) or (2, 4, 2, 1, 1) as in Table A.2.1-4 in TR 38.802 are both fine for us.  We need make similar change as FR1 on DMRS configuration, number of repetitions and HARQ configuration. |
| Nokia/NSB | Similar comments for UE speed as for Proposal 16 apply (i.e., remove 120 Km/h).  We should not simulate explicitly HARQ for eMBB.  Slot-aggregation and retransmissions should be considered for VoIP however their number shall be compatible with the adopted frame structure. Otherwise results would be scarcely relevant in practice.  Furthermore, to reduce simulation workload and simplify the step of results comparison, it would be wiser to down select among available options. For example, number of TxRUs for PUSCH. We think that since PUSCH is bottleneck channel in most of the initial evaluation results, using only one TxRU could help increasing beamforming gain when number of antenna elements is larger. In addition, it should be noted that 2 DMRS symbols should be sufficient for higher speed UEs, given that the more DMRS symbols, the less available resource for data transmission, i.e., higher MCS must be selected to guarantee same TBS. From our perspective, both theory and practice should suggest that lower code rates are always preferable to extend coverage, and MCL gains due to lower code rates can overperform SINR gains due to better channel estimation. |
| Qualcomm | We think UL CP-OFDM should be also included in the evaluation |
| CATT | Similar comments as FR1, i.e. DMRS configuration should be defined for each hop and the same parameter used in FR1 can be reused here. And VoIP should be deprioritized. |
| Samsung | As discussed in FR1, for HARQ configuration of VoIP, the maximum number of HARQ transmission depends on the frame structure for TDD and latency requirements for VoIP. |
| Apple | If intra-slot frequency hopping is enable, 1 DMRS symbol is for each hop. |

**Proposal 18:**

* For link level simulation, adopt the following table for PUSCH and PDSCH for FR2.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Number of antenna elements for BS | Indoor scenario: 128  Urban scenario: 256  Suburban: 256 |
| Number of TxRUs for BS | 2 |
| Channel model for link-level simulation | CDL- A, [CDL-C], TDL-A |
| Delay spread | Indoor scenario: 30ns  Urban scenario: 100ns  Suburban scenario: 100ns |
| Latency requirements for voice | 50ms/100ms |
| PRBs/TBS/MCS | Reported by companies. |

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| **Companies** | **Comments** |
| Ericsson | BS antenna configurations & gain, including RF losses Follow the modeling of ITU M.2412  Indoor:   * AAS 128 antenna elements with (M,N,P,Mg,Ng) = (8,8,2,1,1); tilt: 3 deg * 2T2R for analog beamforming case; other values not precluded * 23dBi total max gain   Urban:   * Antenna near the ceiling, panels in 3 sector configuration. AAS 512 antenna elements in 4 panels with (M,N,P,Mg,Ng) = (8,8,2,2,2); tilt: 12 deg * 2T2R for analog beamforming case; other values not precluded * 26dBi total max gain   TDL models should use medium correlation  Prefer that voice latency requirements are square bracketed for now, so we can check. |
| Intel | We also prefer TDL-A model for link level simulations. Further, similar to FR1, we suggest to add the number of symbols for PDSCH/PUSCH, e.g., 12/14 symbols. |
| Huawei, HiSilicon | TDL should be removed since CDL with angle spread is necessary for FR2.  CDL-C is preferred but only with CDL-A if it has majority of supports. |
| **Sony** | We support the proposal, CDL channel model needs to be used in LLS. |
| InterDigital | We support to use CDL models and 14-symbol PUSCH for evaluation. We also propose to have (M, N, P, Mg, Ng) definition here as well. We can refer to A.2.5 or Table A.2.1-4 in TR 38.802 for configurations. For Indoor, we can use (M, N, P, Mg, Ng) = (8,8,2,1,1). For Urban we can use (M, N, P, Mg, Ng) = (4, 8, 2, 2, 2) with (dH, dV) = (0.5, 0.5)λ. (dg,H,dg,V) = (4.0, 2.0)λ. Radiation pattern should also be agreed. We support 50ms for latency requirement for voice, to reduce simulation load. |
| vivo | Agree with the proposal |
| ZTE | The antenna configuration needs further clarification. Same as InterDigital, (8,8,2,1,1) for indoor and (4, 8, 2, 2, 2) for urban scenario are preferred. |
| Nokia/NSB | Regarding the channel model for Urban, we noticed that majority view seems to be TDL-C not TDL-A. We propose to add TDL-C in the table for the evaluation of Urban scenario. Regarding the delay spread, although our first preferences are TDL-A 26ns for Indoor and TDL-C 263ns for Urban, we are fine to follow majority view.  Concerning PRBs/TBS/MCS, our opinion is the same as for FR1. It is important to agree on the methodology in order to ensure results will be comparable. 64qamLowSE MCS table should be considered in order to test the lowest possible code rates available in NR, with no “hardcoded” restriction on the number of allocated PRBs. This is arguably more important for FR2 study, given the lack of relevant prior studies on this in 3GPP. From our perspective, we cannot use a static LA approach to study coverage problems, which by nature are very different from throughput studies. We propose to add in the proposals that 64qamLowSE MCS table is considered in the study, given that all the relevant lowest code-rates of the 64qam table are embedded in the 64qamLowSE MCS table from line 7 to 11. In fact, our goal in this SI should be to investigate the maximum coverage each PxSCH can have in general, and not the maximum coverage each PxSCH can have if configured in a very specific and surely sub-optimal way (both practically and theoretically). We have serious concerns about this fact, because it can hinder the validity and practical relevance of what we will do in the context of the SI. |
| Qualcomm | Support for unicast. But for broadcast and RACH, the number of SSB beams (and the gain difference between unicast and broadcast beams) should be specified. |
| CATT | The table can be further updated once FR1 assumptions are determined. |
| Samsung | For the number of PRBs, similar to FR1, we suggest to agree on baseline values to be used for evaluation benchmark: 30PRBs for urban and indoor eMBB and 4PRBs for suburban eMBB, 4 PRBs for VoIP. Other values of PRBs can be reported by companies. |

**Proposal 19:**

* For link level simulation, adopt the following table for PUCCH for FR2.

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| --- | --- |
| **Parameters** | **Values** |
| PUCCH format type | Format 1, 2bits UCI  Format 3, 11/22 bits UCI |
| BLER for PUCCH | For PUCCH format 1:  DTX to ACK probability: 1%. NACK to ACK probability: 0.1%, ACK missed detection probability: 1%.  For PUCCH format 3:  Block error probability: 1% |
| Number of PRBs for PUCCH | 1 PRB |
| Number of UE antennas for PUCCH | 1 |
| Number of UE TRXUs for PUCCH | 1 |
| Number of receive antenna elements for BS | Indoor scenario: 128  Urban scenario: 256  Suburban: 256 |
| Number of receive TxRUs for BS | 2 |
| Number of repetitions for PUCCH | w/ and w/o repetition for PUCCH.  The maximum number of repetitions can be 2/4/8. |

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| --- | --- |
| **Companies** | **Comments** |
| Ericsson | **Format 3 with 4 bits Ack/Nack**:  PUCCH Format 3 using 14 symbols, 1 PRB, 4 DMRS and frequency hopping  4 bits payload for ACK/NACKS (three bits for 3DL:1UL TDD asymmetry and another bit for scheduling request)  Pr(DTX to ACK) <=1%, Pr(NACK to ACK) <=0.1%,  Pr(ACK error) <=1% or 10%  **CSI on PUCCH format 3 or PUSCH:**  Type I wideband CSI feedback  - 8+2=10 bits for 2 port feedback + 3bit CRI  1 PRB, no HARQ ACK/NACKs  - PUCCH format 3 with 4 DMRS, with frequency hopping, or  - PUSCH without multiplexing with data on PUSCH and no frequency hopping  TXRUs should not be specified for the UE; UE should have 1T2R or 2T2R  gNB antenna configuration & TXRUs should be the same as PUSCH (as well as other UL & DL channels) |
| NTT DOCOMO | **PUCCH format**  We should include short formats (format 0 and 2) for FR2, since beam forming (may be with large number of antenna beams) is necessary for coverage extension in FR2, and short formats can be FDMed with other channels with two symbols (e.g. PRACH) for each antenna beams. (otherwise, PRACH and PUSCH resource for every antenna beams need to be configured for different OFDM symbols.) In addition, in FR1, long formats (format 1 and 3) are selected, so if we don’t consider short formats in FR2, it means we exclude short formats from our coverage study, and it’s not good situation in the view point of operators. (We can use the same payload size and BLER target as that for format 1 and 3.) |
| **Intel** | We are generally fine with the proposal. We suggest to add the number of symbols for PUCCH, i.e., 14 symbols and the number of DMRS symbols for PF3, similar to FR1. |
| Huawei, HiSilicon | OK |
| Sony | The number of UE antennas should be the aligned with Proposal 17. We do not see a particular reason why the UE would change the number of antennas here. We assume the rank of transmission is 1. |
| vivo | We are fine with the proposals. |
| ZTE | Support the proposal. |
| Nokia/NSB | We are fine with the proposal, except for the PUCCH repetition which, in our view, should be removed for the reasons we gave in the reflector. It is not clear to us how this aspect can be simulated unless very specific scheduling assumptions are made. PUCCH and PUSCH repetitions work very much differently. The latter can be easily modeled, if necessary, given that only consecutive slots are considered and that different redundancy versions are used. The former is practically a HARQ process which can last much longer and that also changes the measured BLER from iBLER to rBLER. Furthermore, the benefits of this approach are not clear. We would suggest removing it completely from the proposals. |
| Qualcomm | Support |
| CATT | The same consideration for FR1 should be applied here. |
| Samsung | We are agree with Sony. We do not understand why the number of UE antenna elements for PUCCH is different to that for PUSCH in Proposal 17. |

**Proposal 20:**

* For link level simulation, adopt the following table for PDCCH for FR2.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| aggregation level | 16 |
| payload | 40 bits |
| CORESET size | 2 symbols |
| CCE-to-REG mapping type | interleaved or non-interleaved mapping |

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| Ericsson | CORESET 66 PRBs, 1 symbol, non-interleaved mapping,  precoder cycling |
| Intel | We suggest to add CORESET size in frequency, i.e., 48 PRBs same as FR1. |
| Huawei, HiSilicon | Support |
| vivo | We are fine with the proposals. Beamforming gain should also be considered |
| ZTE | Support |
| Nokia/NSB | Support the proposal. |
| Qualcomm | Support for unicast. But there should be clear and reasonable assumption on the number of SSB beams (or the beam gain difference between unicast and broadcast) which is important for the performance of msg2 PDCCH and RMSI PDCCH. |
| CATT | If 48 RBs are assumed for PDCCH, we don’t need to consider different mapping types. |
| Samsung | We prefer to support both broadcast and unicast. For FR2 and unicast, it can be assumed that CORESET size is 1 symbol with TDM due to the narrow beam. Then, aggregation level is also assumed as 4 or 8 since the mapping resource is insufficient in case of 100MHz BW and 120kHz SCS.  Moreover, we prefer REG bundling size as 2. |

**Proposal 21:**

* For link level simulation, adopt the following table for PRACH for FR2.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Format type | Format B4, Format C2 |
| Scheduled PRBs | 12 PRBs |
| Performance metric | 0.1% false alarm, 1% miss-detection |

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| --- | --- |
| **Companies** | **Comments** |
| Ericsson | 10% or 1% missed detection at 0.1% false alarm probability. Format B4 should be used for maximum coverage. |
| Intel | We also support format B4 for PRACH. Suggest to consider single PRACH format to reduce simulation effort. |
| Huawei, HiSilicon | Support |
| vivo | PRACH format B4 is preferred. |
| ZTE | Support |
| Nokia/NSB | Support. |
| Qualcomm | We think there should be clear and reasonable assumption on the number of SSB beams (or the beam gain difference between unicast and broadcast) which is important for the performance of PRACH. |
| Samsung | We support B4 but C2 could be optional. Based on the format itself, the delay budget of C2 is larger than the B4 (i.e., larger CP length), but B4 has better link budget (i.e., more repetitions). |