**-3GPP TSG RAN WG1 Meeting #102-e R1-20xxxxx**

**e-Meeting, August 17th – 28th, 2020**

**Source: Moderator (SoftBank)**

**Title: [102-e-NR-CovEnh-01] Summary on A.I. 8.8.1.1 baseline coverage performance using LLS for FR1**

**Agenda Item: 8.8.1.1**

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# Introduction

This paper summarizes the contributions submitted to A.I 8.8.1.1 (Study on NR coverage enhancement - Baseline coverage performance using LLS – FR1) and 8.8.3, which are relevant to simulation assumptions.

Note the header labelled at each section name means the following:

* **[H]**: high priority aiming at the discussion/approval on 8/20(Thu)
  + These items are controversial, impact on other discussion, and/or require 2nd phase discussion
* **[M]**: Medium priority aiming at the discussion/approval on 8/26(Wed)
  + These items are important for simulations, but have isolated impact to other topics.
* **[L]**: For last check on 8/28 (Fri)
  + These items are binary decision, or less controversial.

1st round

Companies are encouraged to input their views to section 2 and 3 until 12:00UTC on 8/19(Wed). Feature lead summary will be provided a couple of hours after this deadline.

2nd round

Companies are encouraged to input their views to section 2 and 3 **until 11:59 am UTC on 8/27(Tue) at least for [H] and [M] items**. Feature lead summary will be provided a couple of hours after this deadline.

# Open issues

## Stable - [M] Open issue No.1 - TBS for SIP invite (FR1 & FR2 common)

Open issue No.1 is the TBS for SIP invite message. We had a proposal for payload size, but no proposal was made for the corresponding TBS.

TBD: TBS for SIP invite message. Payload of 1500 bytes can be a starting point.

A detailed proposal on the TBS and number of segments was provided by [24] .

Table 1. Payload of SIP message and segmented TBS

|  |  |  |  |
| --- | --- | --- | --- |
| Example | SIP message | TB size | Segment |
| VoLTE | 2000 bytes | 56 bytes | Around 40 |

*Notes*: The TB size is captured from real network for weak coverage scenario.

* *For SIP evaluation, 56 bytes is the TB size to convey SIP message.*
* *To ensure the coverage of VoIP with acceptable VoIP delay including voice delay, ringing delay and call setup delay, 64kbps as a minimum target IP data rate of VoIP can be a starting point.*

Note that the required time period to complete the transmission is not discussed in this contribution, while R1-2003464 submitted to RAN1#101-e proposed 500ms for the worst case.

Interested companies are invited to input their views on the following aspects:

* SIP message size: 1500 bytes or 2000 bytes
* TB size: 56 bytes or any other value
* Number of segments: 40 or any other value
* Required time period: 500ms or any other value
* Requirement on PUSCH data rate for VoIP

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | Fine to consider SIP message as an optional service. The assumptions could be reported by interested companies.  Regarding the data rate for VoIP, our preference is a packet size of 320 bits with 20ms data arriving interval. |
| Panasonic | We are fine with SIP invite message of 1500 bytes |
| Intel | SIP invite message can be considered as optional for link budget analysis.  For VoIP, we prefer TBS of 320bits in the link level simulations. |
| SoftBank | Considering the less number of input from the companies, we can conclude as follows:  - Payload of 1500 bytes can be a starting point. - The assumptions are reported by interested companies. - Contributions R1-2003464 and R1-2005259 are taken into account for the evaluation. |
| Ericsson | * We agree that SIP is important to consider for NR coverage. * 2000 bytes is reasonable, but TB size of 56 bytes is probably too large. With 2kB and 500ms max delay, then the data rate is 16 kbps, which is similar to the VoIP codec rate. Perhaps ~320 bits can be a starting point? |
| Qualcomm | SIP procedure and the SIP invite message are indeed a potential bottleneck for providing voice services. The nature of this issue is however complicated by the fact that the the SIP timers can be extended to potentially more than a second to allow for the SIP message to transmitted successfully. Nevertheless, we think the large number of segments will continue to remain an issue. Proposals to limit the number of segments will be quite helpful.  We are okay with the SIP message size, but don’t want to impose a TB size. Similarly for the time period, we think extending up to 1 second can be considered, while noting that the SIP procedure has timers for the entire procedure and not just for the delivery of SIP invite message. |
| Samsung | Fine with above Softbank’s comment. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Support Ericsson proposal |
| Huawei, Hisilicon | The maximum payload size for SIP message (e.g. SIP\_INVITE, SIP\_update, etc.) is within 1500~2000 bytes typically and the large payload in PDCP layer will be segmented into multiple RLC segments, MAC packets and TBs with higher layer headers. A larger payload size of 2000byte can be considered as a start point to when taking RLC and MAC overheads into consideration and ensure the coverage under worst case. The TB size captured from real network is 56 bytes with around 40 segments, and VoLTE evaluation with robust MOS scores show that 64kbps IP data rate (above PDCP layer) should be achieved. |

**Summary of the discussion:**

As pointed by companies, this is a complicated issue, and it is not so easy to come up with a single assumption for evaluation. In addition, the proposal by [24] needs more discussion among companies to achieve the common understanding. Given this situation, the following is proposed:

**Moderator’s updated proposal:**

* for SIP invite message
  + Payload of 1500 bytes can be a starting point.
  + The assumptions (TB size, time period etc.) are reported by companies.
  + Contributions R1-2003464 and R1-2005259 are taken into account for the evaluation.
    - In addition, 1 second time period can also be considered.

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | OK with moderator’s updated proposal |
| Intel | Our understanding is that SIP invite message is optional for link level simulations. If this is correct understanding, it would be good to update it as “SIP invite message is optional for LLS” |
| Qualcomm | We are fine with the proposal as it stands, no need to further condition it as being optional. Any sim is optional anyway. |

**Summary of email discussion**

* 3 companies joined the discussion
* 2 companies are OK for the moderator proposal
* 2 companies provided their view on the optionality of this evaluation
  + 1 company proposed to explicitly capture this is an optional.
  + 1 company mentioned such clarification is not necessary because any simulation is optional

Moderator agrees the comment “any simulation is optional”. Otherwise, we have to check all the agreements and add “optional” for many places. Therefore, moderato would like to propose the following for approval:

**Moderator’s proposal:**

* for SIP invite message
  + Payload of 1500 bytes can be a starting point.
  + The assumptions (TB size, time period etc.) are reported by companies.
  + Contributions R1-2003464 and R1-2005259 are taken into account for the evaluation.
    - In addition, 1 second time period can also be considered.

## Closed - [H] Open issue No.2 – CDL for link level simulation (FR1 only)

Open issue No.2 is the use of CDL for link level simulation, which has not been agreed yet.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Channel model for link-level simulation | TDL-C for NLOS, TDL-D for LOS.  [CDL] |
|  |  |

There are not many contributions discussing about this issue, especially for the support on CDL. Therefore, in order to reduce the companies’ efforts on simulation campaign, the following proposal is made.

**Moderator’s proposal**

* Remove CDL from the channel model for link-level simulation.
  + This does not preclude companies from performing the link-level simulations using CDL

Companies are invited to input the views on the moderator’s proposal.

|  |  |
| --- | --- |
| Company | Comment |
| OPPO | Support removing CDL from the channel model for link-level simulation.  Antenna gain and beamforming gain can be included in the link budget template when using TDL model, there is no need to use CDL for link-level simulation. |
| CATT | Support FL’s proposal |
| ZTE | Fine with the proposal. |
| Panasonic | We support the moderator’s proposal. |
| Nokia/NSB | Ok. |
| Intel | We are fine with FL’s proposal. |
| NTT DOCOMO | We support FL proposal. |
| Ericsson | While we don’t have a strong view, we are fine with reporting TDL based results in the link budget templates. However, we don’t yet see why we need to remove the channel model from link level simulations. For example, we may wish to capture CDL based results in the TR to explain e.g. how antenna gain values are compensated for effects such as channel estimation and angle spread in the link budget templates. Would it be more clear to phrase the proposal as follows?   * TDL models are used to generate results in the link budget templates |
| Qualcomm | We were the primary proponents of using CDL, which we thought was essential to evaluate MMIMO systems. But considering the general lack of support in running accurate simulations, and to better align our results with other companies, we have switched to using TDL in our simulations. While we know this is unlikely to accurately reflect absolute coverage performance, this may be good enough for relative comparisons.  We reluctantly agree to drop CDL. |
| InterDigital | We support the proposal from FL |
| vivo | We agree with the proposal for FR1.CDL model can be considered in FR2. |
| Samsung | Support moderator’s proposal. |
| Sharp | We are OK with FL proposal. |
| Apple | We support the FL’s proposal |
| SONY | OK with FL proposal |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Support the proposal |
| CMCC | We are fine with FL’s proposal |
| Huawei, Hisilicon | Support the moderator’s proposal.  We prefer TDL channel model in LLS to reduce the simulation workload with antenna array gains modelled with adjustments in Section 3.3. |

**Summary of the discussion:**

* 14 companies support moderator proposal, i.e. drop CDL
* 1 company mentioned that they can accept to drop CDL, even though it is not their preference
* 1 company mentioned that CDL can be considered in FR2
* 1 company proposed to rephrase the proposal as “TDL models are used to generate results in the link budget templates” because CDL model may be used to for other purpose e.g. antenna gain compensation.

Taking this summary into consideration, the moderator proposal is updated as follows.

**Moderator’s updated proposal:**

* TDL models are used to generate results in the link budget templates
  + This does not preclude companies from performing the link-level simulations using CDL

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Support |
| InterDigital | We support the moderator’s updated proposal |
| OPPO | Support |
| Samsung | Support |

**Summary of the discussion at the GTW on 8/20**

Agreements:

* TDL models are used to generate results in the link budget templates for FR1
  + This does not preclude companies from performing the link-level simulations using CDL

It was clarified during the GTW that this agreement implies [CDL] is removed from the table:

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Channel model for link-level simulation | TDL-C for NLOS, TDL-D for LOS.  ~~[CDL]~~ |
|  |  |

Given this agreement the discussion on open issue No.2 is closed.

## Discussion needed - [H] Open issue No.3 – link budget template (FR1 & FR2 common)

This issue is to choose the link budget template:

* *Down selection on the following options for the link budget template for FR1 in next meeting.*
  + *Option 1: Adopt single link budget template based on IMT-2020 self-evaluation with necessary revisions, including adding/removing/revising some parameters.*
    - *FFS: The template provided by FL in Tdoc R1-2005005.*
  + *Option 2: Adopt both templates, i.e. link budget template in IMT-2020 self-evaluation and link budget template in TR 36.824.*
  + *Option 3: Adopt single link budget template in TR 36.824 with necessary revisions, including adding/revising some parameters.*

Additionally, [7] and some other contributions have proposed to add some rows to show MCL/MIL in IMT-2020 table (hereafter this is called as option 1’) as a compromise. Note that, as discussed in section 3.1, the definition of MCL, MIL is not clear. So, this point is intentionally left ambiguous at this moment.

In summary we now have four options for discussions.

* Option 1:
  + Adopt single link budget template based on IMT-2020 self-evaluation with necessary revisions, including adding/removing/revising some parameters.
    - FFS: The template provided by FL in Tdoc R1-2005005.
* Option 1’:
  + Adopt single link budget template based on IMT-2020 self-evaluation with row(s) for MCL (and/or MIL) and necessary revisions, including adding/removing/revising some parameters.
* Option 2:
  + Adopt both templates, i.e. link budget template in IMT-2020 self-evaluation and link budget template in TR 36.824.
* Option 3:
  + Adopt single link budget template in TR 36.824 with necessary revisions, including adding/revising some parameters.

We didn’t see clear majority for each option as well as a crucial argument to choose one from the above options. Hence, the moderator would like to propose to adopt a compromise solution (i.e. option 1’ or 2) to accelerate the discussion.

**Moderator’s proposal**

* Adopt option 1’ or 2
* The detailed discussion on link budget table will be taken place at the 2nd phase email discussion of RAN1#102-e.

Companies are invited to share the views on the moderator proposal:

|  |  |  |
| --- | --- | --- |
| Company | Preferred option | Comments |
| China Telecom | Option 1’ | We prefer option 1’.  From our view, we care more about what NR can achieve in term of coverage performance at present, as well as the gap between the baseline performance and target performance. Hence, we prefer to use IMT-2020 link budget template, which has the following advantages:  1) Companies have experience in the simulation for IMT-2020 submission, and have submitted results based on IMT-2020 template to ITU.  2) IMT-2020 template provides comprehensive parameters, which contains all the parameters in 36.824 link budget template. Then the results based on IMT-2020 template are more accurate than 36.824 link budget template.  3) Target MPL or MCL can be derived from ISD, while ISD can be provided based on operators’ practical deployment. Operators can better understand the gap between the baseline performance and the target. |
| OPPO | option 1’ | * The link budget template based on IMT-2020 self-evaluation has been well discussed in ITU self-evaluation, and it has more detailed factors (including antenna gains, shadowing, penetration loss and so on). * The MPL based IMT-2020 may provide more intuitive and precise assessment. Meanwhile, MCL can also calculate based IMT-2020 if it’s needed for some companies.   Modification ontop of MCL could be one way forward. |
| CATT | Option 1’ | The link budget template used in IMT-2020 self-evaluation has been developed very well during evaluate the coverage of NR system. It is a straightforward and rational way to go with Option 1’.  Furthermore, the more practical parameters included in the IMT-2020 template provide more room to help people balance the simulation load and accuracy of the evaluation results. |
| ZTE | Option 1’ | Our first preference is Option1 while would be fine with Option 1’s for progress. But, as for MIL, clarification is needed. It’s better the proponent to clarify what’s the exact definition of MIL. If it is the definition as provided in section 3.1, isn’t it the hardware link budget in the row 23(a) or (23b) in the ITU link budget template? |
| Panasonic | Option 1’ | Option 1’ seems good compromise between Option 1 and Option 3. |
| Nokia/NSB | Option 1 or Option 1’ | From our perspective, IMT-2020 LB template offers the flexibility to compute several metrics of interest explicitly (MCL and MPL). If MIL is considered a metric of interest by the majority, to be calculated explicitly, this is also fine by us. In this sense, both Option 1 and Option 1’ are good choices. |
| Intel | Option 1’ | In our view, as link budget template based on MPL is well defined at least for FR1, it is preferable to adopt MPL as performance metric and reuse the parameters in link budget template for various deployment scenarios. Further, given that MCL can be straightforwardly calculated based on the link budget template, e.g., adding two rows for MCL calculation for data and control channels, we are also fine to consider MCL as performance metric for link budget analysis.  Hence, we can consider both MPL and MCL based performance metric. |
| NTT DOCOMO | Option 1’ | The link budget table may be revised for the target metric (MCL/MIL/MPL) which will be defined. Therefore, the table may be defined once the metric will be defined, and Option 1’ can be used for the target metrics. |
| SoftBank | Either option is OK | If the necessary information is shown in the link budget table, either option is acceptable to us. |
| Ericsson | Option 3 with MIL (first choice) or Option 1’ (second choice) | The drawback of the IMT-2020 is its complexity: aligning views on all the parameters may be difficult. Given MIL and MCL, it is hard to see what the benefit of calculating available path loss is in the context of the study, since the bottlenecks are already known. Adding antenna gain to calculate MIL in an updated 36.824 template seems like it should be much more efficient and allow better alignment of results. On the other hand, as long as there is some flexibility in the IMT2020 template, it is certainly feasible. |
| Qualcomm | Option 3 | Similar views as Ericsson. IMT-2020 is unnecessarily complex and doesn’t yield any new insight. We also have not agreed to any of the parameters necessary for using IMT-2020 table. |
| InterDigital | Option 1’ or Option 3 | Prefer Option 3 to modify the template in TR 36.824 to add necessary parameters but for progress we can support Option 1’. |
| Vivo | Option 1 | Considering evaluation methodologies have been well discussed in ITU self-evaluation, using IMT-2020 self-evaluation template may be an adoptable choice. |
| Samsung | Option 1’ | Our 1st preference is option 1 with the same reasoning provided by China Telecom. We can accept option 1’ |
| Sharp | Option 1’ | Single template is preferred. |
| Apple | Option 1 | Option 1 is clear, the MPL will be used as the target performance metric. For Option1’, does it mean either MPL or MCL or both could be used as target performance metric? |
| SONY | Option 1’ | Our preference is to use the IMT-2020 methodology as companies have experience with this and it already contains some parameters that are lacking from the 36.824 template (like the antenna gains / array gains) and are different between NR channels. Our preference is to consider the hardware link budget (in items 23a / 23b), since calculating the pathloss (29a / 29b) is very dependent on scenario assumptions (penetration loss) etc and doesn’t provide new information. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Option 1’ | Option 1’ subsumes Option 1 in our understanding. |
| CMCC | Option 1’ | The IMT-2020 template is preferred. It is more comprehensive and informative which provides detailed and clear parameters impacting the coverage. It could be referred for the practical deployment and analysis.  Also the MCL and MIL could be derived from the same table to satisfy different companies’ preference. |
| Huawei, Hisilicon | Option 1, Option 1’ | We prefer reusing IMT-2020 self-evaluation template in Option 1, Option 1’ with necessary revisions to identify the coverage bottleneck channels since TR 36.824 is not effective to identify the coverage gap for a given cell radius where some key parameters are not included, such as penetration, shadow fadings, etc., in practical implementations. |

**Summary of the discussion:**

* 15 companies are fine with, or can accept option 1’
* 2 companies still have a preference on option 1
* 1 company still have a preference on option 3

Considering the fact that option 1’ is a compromise solution and it is obviously a superset of option 1. Therefore, there is no strong necessity to have a competition between option 1 and 1’.

**Moderator’s updated proposal:**

* Adopt single link budget template based on IMT-2020 self-evaluation with row(s) for MCL (and/or MIL) and necessary revisions, including adding/removing/revising some parameters.

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Can accept |
| InterDigital | For progress, we support the updated proposal from the moderator |
| China Telecom | Support |
| OPPO | Support |
| Samsung | Support |
| CMCC | If my understanding is right, current proposal means adding new rows for MCL(and/or MIL). If so, we support the proposal. |

**Summary of the discussion at the GTW on 8/20**

**Proposal:**

* Adopt single link budget template for both FR1 and FR2 based on IMT-2020 self-evaluation with new row(s) for MCL (and/or MIL) and necessary revisions, including adding/removing/revising/simplifying some parameters
  + Aim to conclude the necessary revisions by the end of this e-meeting

It was recommended by Chairman to jointly discuss with target performance metric (Open issue No.14) . In order to address the issues brought up during GTW, moderator would like to propose the following as a way forward.

**Moderator’s updated proposal**

* Adopt single link budget template for both FR1 and FR2 based on IMT-2020 self-evaluation with new rows for MCL, MIL and necessary revisions, including adding/removing/revising/simplifying some parameters
* Coverage bottleneck identification is performed using MPL, MCL and MIL.
* ,
  + The results based on MPL are to be captured in TR and the intention is to show the achievable ISD for information.
  + The definition of MPL shall be determined in RAN1
  + RAN1 will not spend time on the value for the parameters, which do not impact on MCL and MIL but MPL
    - The use of IMT-2020 value is implicitly recommended. If not available, companies can report it.
* RAN1 strives for satisfying the operators’ requirements
  + The details of “operators’ requirements” will be clarified at RAN1#103-e, which means that operators are encouraged to prepare a joint proposal.

Please keep in mind that this is a compromise taking into account the companies’ preference and concerns as much as possible. Companies are encouraged to provide their views on this proposal, especially for the critical concern on it, if any

.

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Our intention of keeping MPL, MCL and MIL on same footing is that companies can report on which basis the coverage bottle neck is identified, we believe that relative comparison doesn’t differ too much and ultimately the observation will not change.  Another aspect is about the target, if the target ISD is too high it maybe unreachable. |
|  |  |
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**Moderator’s updated proposal on 8/24**

After the email discussion, the moderator proposal is modified as follows:

* Adopt single link budget template for both FR1 and FR2 based on IMT-2020 self-evaluation with rows for MIL, MCL, MPL, and necessary revisions, including adding/removing/revising/simplifying some parameters
* [For LLS based methodology,  ]coverage bottleneck(s) identification is performed using at least [MCL and] MIL.
  + [MCL values can also be considered to compare channels with similar antenna (and antenna array) gain]
* MPL ~~is kept in the link budget table and~~ can be used as  supplemental information for coverage bottleneck(s) identification
  + The results based on MPL are to be captured in TR and the intention is to show the achievable ISD for information.
  + The definition of MPL shall be determined in RAN1
  + RAN1 will not agree on specific values for the parameters related to MPL
    - IMT-2020 values can be a starting point, but companies may use other values.
* RAN1 strives for satisfying targets identified by operators
  + They are expressed in the form of:
    - 1. Scenario dependent ISD/MPL targets;
    - 2. Service dependent MCL targets, e.g., [147] dB for VoIP;
    - 3. Relative MIL(/MCL) difference between channels.
  + Further values and details of such targets will be clarified at RAN1#103-e, which means that operators are encouraged to prepare a joint proposal.
  + Note: Study item objectives are according to the study item description, and not changed in RAN1 by the targets.

**Summary of the GTW on 8/24**

Agreements:

* Adopt single link budget template for both FR1 and FR2 based on IMT-2020 self-evaluation with rows for MIL, MCL, MPL, and necessary revisions, including adding/removing/revising/simplifying some parameters
  + [For LLS based methodology, ]coverage bottleneck(s) identification is performed using at least [MCL and] MIL.
  + [MCL values can also be considered to compare channels with similar antenna (and antenna array) gain]

Agreements:

* MPL can be used as supplemental information for coverage bottleneck(s) identification
* The results based on MPL are to be captured in TR
  + Note: this is uself to show the achievable ISD.
* The definition of MPL shall be determined in RAN1
* RAN1 will not further discuss on specific values for the parameters related to MPL
  + IMT-2020 values are as a starting point, but:
    - companies may use other values, and
    - for the parameters that companies think IMT-2020 self-evaluation does not clearly define the values for some scenarios, it is up to companies to report

Agreements:

* RAN1 strives for satisfying appropriate targets identified by companies particularly operators
  + The targets may be in the form of one or more of the following:
    - 1. Scenario dependent targets, e.g., ISD/MPL
    - 2. Service dependent targets, e.g., [MCL=147] dB for VoIP;
    - 3. Relative difference between channels, e.g, MIL(/[MCL])
  + Further values and details of such targets will be clarified at RAN1#103-e
  + Note: there is no intention in RAN1 to update the study item objectives due to the identified targets.

Remaining issue is the resolution for square brackets in the first agreement (highlighted with yellow shadow)

**Moderator’s proposal for the remaining issue:**

* Alt 1:
  + For LLS based methodology, coverage bottleneck(s) identification is performed using at least MIL.
  + MCL values can also be considered to compare channels with similar antenna (and antenna array) gain
* Alt 2:
  + Coverage bottleneck(s) identification is performed using at least MCL and MIL.

From moderator point of view on the first issue “For LLS based methodology”, RAN1 agreement at #101-e says “The evaluation methodology based on system-level simulation is optional for FR1.” Considering the fact that Alt 2 tries to exclude SRS based approach, which is somewhat violate to the former agreement.

As for the second issue on “MCL for coverage identification”, it is widely acknowledged that MCL applicability depends on whether or not the difference on beamforming gain among channels should be assumed. In this sense, moderator doesn’t see the critical problem on Alt.1, but Alt.3 can be considered as a potential solution:

* Alt 3:
  + For LLS based methodology, coverage bottleneck(s) identification is performed using at least MIL.
  + MCL values can also be used to identify the coverage bottleneck(s) when applicable ~~considered to compare channels~~ , e.g. comparing channels with similar antenna (and antenna array) gain

Interested companies are encouraged to provide their views:

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | Support the proposal.  As FL mentioned, system-level simulation was agreed as an optional methodology, while the proposal here only intends to cover LLS based methodology. |
| Samsung | Fine with either Alt 1 or Alt 3 |
| Nokia/NSB | Fine with either Alt 1 or Alt 3 |
| Intel | Fine with either Alt 1 or Alt 3. But we would like to clearly define how to identify the performance bottlenecks. Is this correct understanding that this would be the next step and will be discussed in next meeting? |
| Ericsson | Prefer Alt 1, unless a use case for MCL where channels are compared that do not have similar antenna gain can be identified. If such a case is identified, then Alt 3 is fine as well (and should probably be updated to reflect the case).  Regarding Intel’s question: our understanding is that the bottleneck channel is the one that limits coverage the most. When there are N bottlenecks, they are the N channels that limit coverage the most. |
| NTT DOCOMO | We are fine with either Alt 1 or Alt 3. |
| Qualcomm | Alt 2. The reasoning is as follows:  There are at least 2 different approaches being pursued by companies (LLS-only and SLS+LLS. Any agreement we have here must equally apply to both these approaches. To keep the phrase “For LLS based methodology” would imply that companies who pursue SLS+LLS are not bound by this agreement. This I hope is not the desired outcome. We therefore prefer to drop the conditioning “For LLS based methodology”.  For the same reason, we wish to have MCL and MIL on an equal footing. As I have explained earlier, MCL to MIL jump is non-trivial when considering SLS. In LLS with TDL channel model, there is no geometrical/angular information coming into play. This is true irrespective of whether LLS or SLS+LLS methods are used. For this reason, MCL provides a common reference point before specific aspects of SLS begin to come into play. Since SLS parameters and setup is up to company preferences, it is also impossible to calibrate across companies if only MIL is considered. |
| vivo | Alt 3 is preferred, since the difference of beamforming gain among channels should be considered. Therefore, MCL cannot be used as the only metric to identify the coverage bottleneck |
| InterDigital | Alt 1 or Alt 3 is acceptable for us. |
| CMCC | Either Alt 1 or Alt 3 is fine. We don’t see much difference between Alt a and Alt 3.  Since MCL cannot reflect the difference of beamforming gain among channels, MIL seems a compromise. |
| OPPO | We are fine with either Alt 1 or Alt 3. |

**Summary of the email discussion:**

11 companies joined the email discussion

* 8 companies are OK for Alt.1
* 1 companies support Alt.2 (not OK for neither alt 1 nor alt 2)
  + reason 1. Applicability to SLS+LLS approach
  + reason 2. If SLS is considered for MIL, MIL provided by companies may not be aligned and the comparison will not be so easy.
* 10 companies are OK for Alt.3
  + 1 company mentioned the use case for MCL need to be clarified (Note: moderator thinks the corresponding sentence is there)
* 1 company mentioned that it should be clearly define how to identify the performance bottlenecks. (Note: this is captured in section 3.9. The discussion will be started under this AI, if possible)

Given the companies comment above, moderator would like to propose Alt-3 based approach as a way forward.

**Moderator’s updated proposal:**

* For LLS based methodology, coverage bottleneck(s) identification is performed using at least MIL.
  + For LLS+SLS based methodology, it is recommended to consider the same approach as LLS based methodology for coverage bottleneck(s) identification
* MCL values can also be used to identify the coverage bottleneck(s) when applicable
  + “applicable” above means the following situation:
    - comparing channels with similar antenna (and antenna array) gain, and/or
    - the simulation results with MIL from companies are diverse, and the comparison with MIL is not easy

Companies are encouraged to input your view, especially for the moderator’s updated proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | **Almost support: clarification with respect to LLS and LLS+SLS methodology is needed.**  Support the intent, but share ZTE’s concern from email discussion with the new ‘LLS+SLS methodology’ wording. My thinking on ‘For LLS based methodology’ was that it was meant to address where the link budget template was used. If the template is not used, then e.g. coverage %ile can be a bottleneck metric. Since a large majority of companies will report according to the template, perhaps it’s not worth optimizing wording for SLS. Moreover, a key factor is that antenna gain numbers reflective of realistic implementation and network operation are used in the templates. Suggest we simply say   * ~~For LLS based methodology, c~~Coverage bottleneck(s) identification is performed using at least MIL.   + ~~For LLS+SLS based methodology, it is recommended to consider the same approach as LLS based methodology for coverage bottleneck(s) identification~~   I appreciate the effort in the MCL text to clarify when it is used. I personally wonder if MCL will be better aligned among companies than MIL, but we can see. So the second set of bullets on MCL are OK for us. |
| Qualcomm | Copy-pasting a proposal I posted on the reflector:  · For LLS based methodology, coverage bottleneck(s) identification is performed using at least MIL or MCL.          o Note: ~~SLS based methodology means the target performance is determined by the X-th percentile SINR point in CDF curve. Even when SLS is used to obtain some components of MIL, it is categorized as LLS based methodology.~~ Even when SLS is used to obtain some components of MIL or MCL, it is categorized as LLS based methodology  I feel that once we add the notes clarifying where the correction terms are accounted for (as captured in email from Nokia), the additional bullets on applicability of MCL may turn out to be unnecessary. |
| ZTE(email) | Regarding issue#, it seems companies have different understandings on what ‘For LLS based methodology’ means. I thought it is what we discussed in last meeting regarding how to determine the two steps (step 1 for required SNR and step 2 for MPL/MCL/MIL) . Under the LLS based methodology, it is still possible to report some of the values by SLS, e.g. antenna array gain. That’s one reason we have the first and third FFS under Option1 in the agreements copied below. Now, some companies may think the phrase will preclude companies to use SLS to obtain some of the components.  To avoid any confusion, it may be not a good idea to use the term ‘LLS+SLS based methodology’ since it’s definition would be even vague. Instead, I suggest to consider the following changes.  · For LLS based methodology, coverage bottleneck(s) identification is performed using at least MIL.          o It doesn’t preclude companies to use SLS to obtain some components of MIL.  The updated note below aligns with my understanding and is much clearer.  > Note: SLS based methodology means the target performance is determined by the X-th percentile SINR point in CDF curve. Even when SLS is used to obtain some components of MIL, it is categorized as LLS based methodology |
| Nokia (email) | the note added for “LLS based methodology” bullet is a welcome addition, as far as we are concerned, which we support. |

**Summary of the email discussion:**

* 4 companies are OK the spirit of moderator’s proposal
  + 3 companies thinks the note is useful , it might not be necessary after RAN1 reaches the common understanding
  + 1 company think fine tuning might not be necessary, thus we can simply remove “For LLS based methodology” in the first main bullet.
  + 1 company wants to remove the 2nd main bullet while 1 company is supportive.

From the discussion above, we need (a bit) more discussion for fine-tuning.

**Moderator’s updated proposal:**

* [(A) For LLS based methodology, ]coverage bottleneck(s) identification is performed using at least MIL. [(C-1) or MCL]
  + [(B) Note: SLS based methodology means the target performance is determined by the X-th percentile SINR point in CDF curve. Even when SLS is used to obtain some components of MIL or MCL, it is categorized as LLS based methodology. ]
* [(C-2) MCL values can also be used to identify the coverage bottleneck(s) when applicable
  + “applicable” above means the following situation:
    - comparing channels with similar antenna (and antenna array) gain, and/or
    - the simulation results with MIL from companies are diverse, and the comparison with MIL is not easy ]

Moderator’s note:

* (A)
  + keep: ZTE
  + remove: Ericsson
* (B)
  + keep: Nokia, ZTE
  + remove (everything or 1st sentence): Qualcomm
* (C)
  + remove (C-1) and keep (C-2): Ericsson
  + keep (C-1) and remove (C-2): Qualcomm

Moderator’s recommendation:

* Keep everything, i.e. (A), (B) (C-1) and (C-2). They might be redundant, but no negative impact is foreseen by keeping them.

Companies are encouraged to input your view on the moderator’s further updated proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | In light of the clarify from Issue 2.4, I feel all this conditioning is redundant.  Prefer to remove C-2.  Okay to keep A, C-1 and second sentence of B to avoid introducing a new term “SLS based methodology” |
| Ericsson | **OK with moderator’s proposal except for a clarification.** If C-1 is kept then, the C-2 bullets should be subbullets under the A main bullet. This is needed given the explanation in C-2 of when MCL is applicable. |
|  |  |

## Discussion needed - [H] Open issue No.4 - antenna array gain (FR1 & FR2 common)

Open issue No.4 is the definition of antenna array gain.

Down selection on the following options for antenna array gain for LLS based methodology for FR1 in next meeting.

Option 1: Antenna array gain is included in the link budget template.

- FFS: array gain = 10 \* 1og10 (number of antenna elements/number of TxRUs)

- FFS: For TDL channel model

- FFS: Values reflective of realistic implementation and network operation.

Option 2: Antenna array gain is included in LLS.

- FFS: For CDL channel model

According to the contributions submitted to this e-meeting, clear majority of companies support option 1 (even though some more discussion for FFS is necessary).

**Moderator’s proposal**

* Adopt option 1, i.e. Antenna array gain is included in the link budget template
  + Note: details of array gain formula is discussed under section 3.3

Companies are invited to share the views on the moderator proposal.

|  |  |  |
| --- | --- | --- |
| Company | Preferred option | Comments |
| China Telecom |  | Whether the antenna gain is included in the link budget template or in LLS depends on the antenna structure.   * For TDL option 1, 2 or 4 gNB receive chains in LLS.   + Antenna component 1 is included in LLS and reflected in the required SNR.   + Antenna component 2/3/4 is are included in link budget template. |
| OPPO | option 1 | The LLS complexity is low, and a more realistic antenna array gain can be obtained by the array gain formula with considering of the antenna gain loss. The loss could be a fixed value. |
| CATT |  | Support FL’s proposal |
| ZTE | Option 1 |  |
| Panasonic | Option 1 | Option 1 could be beneficial to simplify the link level evaluation than Option 2. |
| Nokia/NSB | Option 1 | Option 1 should be preferred. We see two possible approaches to model antenna array gain:   * Hybrid simulation approach. Open-loop 10% BLER SINR is simulated in LLS and antenna gain components 1 to 3 in the diagram shared by China Telecom are calculated using SLS. Antenna gain component 4 is a static parameter, whose value needs to be agreed upon (IMT-2020 value is fine for us). Finally, and using field numbers as per IMT-2020 LB template for simplicity: * SINR value is used for field (19a)/(19b); * Antenna array gain obtained through SLS is used for field (5); * Antenna gain component 4 is used for field (4); * Theoretical array gain calculation can be performed and practically relevant correction factors are used to account for non-idealities.   Finally, according to our results in [3], relative performance of all considered channels does not depend on how antenna array gain is modelled, except for the broadcast/unicast differentiation. Maybe this could be used as a starting point to simplify the discussion. |
| Intel | Option 1 | We are fine with FL’s proposal. As TDL channel model is considered for link level simulations, antenna gain needs to be included in the link budget template. |
| NTT DOCOMO | Option 1 | The antenna gain can be considered in the link budget table as well as the antenna gain. |
| Ericsson | Option 1 | The key is to include realistic values of antenna gain that are reflective of what is observed at the system level. This is particularly important if we wish to have some notion of absolute coverage. We have a similar view to Nokia’s that relative coverage will be easier to align on rather than absolute coverage. |
| Qualcomm | Option 1 | We use the figure in Section 3.1 as a reference and suggest that this gain be split into the 4 components/parameters identified in that figure, along with additional correction factors to account for practical considerations. Companies should then be allowed to address some of these gains as part of LLS or SLS and be absorbed as part of minimum required SINR. |
| InterDigital | Option 1 | Considering there are some remaining issues on the definition of antenna gain, we can include it in the link budget template. |
| vivo | Option 1 | As TDL is expected channel model for FR1, antenna array gain should be included in the link budget template. Besides, the different between unicast BF and broadcast BF should also be considered in link budget template. |
| Samsung | Option 1 | Support moderator’s proposal. |
| Sharp | Option 1 | We are OK with FL proposal. |
| Apple | Option 1 | Option 1 simplify the link level simulation, the antenna array gain is included in link budget template. |
| SONY | FR1: option 1  FR2: option 2 | For FR2 the spatial properties are highly important. We therefore believe that the array gain with realistic antenna patterns should be a part of the LLS. The ability of including antenna array gains in LLS should be at least optional. We assume CDL. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Option 1 | Support Nokia’s proposal and reasoning. |
| CMCC | Option 1 | Antenna array gain should be considered in the link budget to reduce the complexity of LLS.  But the real performance of antenna array gain should be considered, including:   * Non-ideal performance of multiple antenna port at receiver. The process gain of multiple antenna port at receiver should be lower than 10\*log10(antenna port number) * Beamfoming gain losses due to UE location. The beamforming gain of UE located at the boresight and 45o/60o should be different. And UE’s location within one beam could also induce beamforming gain losses. * Beamforming gain losses due to the broader beam width of common channels, such as PBCH. |
| Huawei, Hisilicon | Option1 | Support the moderator’s proposal  Antenna array gain can be included in the link budget template with values discussed in section 3.3. |

**Summary of the discussion:**

* 17 companies support option 1 (For FR1)

Given there is no support for option 2, moderator would like to propose the following.

**Moderator’s updated proposal:**

* For the definition of antenna array gain, adopt option 1, i.e. Antenna array gain is included in the link budget template

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Support |
| InterDigital | We support the moderator’s updated proposal |
| China Telecom | Support |
| OPPO | Support |
| Samsung | Support |
| CMCC | Support |

**Summary of the discussion at the GTW on 8/20**

We had the following agreement at the GTW session:

Agreements (for both FR1 & FR2):

* For the definition of antenna array gain, adopt option 1, i.e. Antenna array gain is included in the link budget template, where there are four antenna gain components
  + Note: the four components are illustrated below – the figure is for illustration purpose only
  + FFS which component(s) are NOT part of the definition of antenna array gain
* 

We have a remaining issue for this agreement, which is “FFS which component(s) are NOT part of the definition of antenna array gain”. In moderator’s understanding, the question brought up during the GTW session is whether or not antenna gain component 4 is included in antenna array gain.

* Alt. 1: Antenna gain component 4 is included in antenna array gain
* Alt. 2: Antenna gain component 4 is NOT included in antenna array gain
  + In this case Antenna gain component 4 corresponds to row No.(4) for transmitter, and row No.(11) for receiver in IMT-2020 link budget template, respectively.

|  |
| --- |
| (4) Transmitter antenna gain (dBi) |
| (5) Transmitter array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, CDD (cyclic delay diversity), etc.) (dB) |
|  |

|  |
| --- |
| (11) Receiver antenna gain (dBi) |
| **(11bis) Receiver array gain (depends on receive array configurations and technologies such as adaptive beam forming, etc.) (dB)** |
|  |

Companies are invited to input their view on this issue.

|  |  |  |
| --- | --- | --- |
| Company | Preferred alt. | Comment |
| ZTE | Alt 2 | In addition, we think component 2 which provides base band digital beamforming gain is also not part of antenna array gain. Considering we also agreed to include component 2 for MCL, it seems anyway we need to add a new row for component 2. |
| Samsung | Alt.2 | For clarity, also suggest to keep above (4) and (11) in the link budget table |
| Nokia/NSB | Alt. 2 | Agree with Samsung. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Alt 2 |  |
| Intel | Alt. 2 |  |
| Ericsson | Alt. 2’ | Agree with Samsung and Nokia that (4) and (11) should be in the link budget table separately. Note that array gain can be set to zero where appropriate.  While this is essentially a book keeping issue, we would like to clarify how component 3 is handled. Component 3 is a fixed mapping that when combined with component 4 has a narrower antenna pattern and a fixed boresight. As such, components 3 and 4 should be taken together in our view, e.g. in parameters (4) and (11) of the IMT-2020 spreadsheet.  The dynamic part of the array gain would then be component 2 only, since the number of degrees of freedom remaining after the TDL LLS is M/k TXRUs.  **So, we would suggest Alt 2’:**   * Alt. 2’: Antenna gain components 3 and 4 are NOT included in antenna array gain   + In this case Antenna gain components 3 and 4 corresponds to row No.(4) for transmitter, and row No.(11) for receiver in IMT-2020 link budget template, respectively. |
| NTT DOCOMO | Alt. 2 |  |
| Qualcomm |  | We have a slightly different understanding from the FL on this discussion.  I think the debate here was on what components to explicitly identify in the link budget table. Of the 4 components, we don’t think we need AGC1 as it is absorbed in LLS across all companies. AGC2 may or may not be absorbed in LLS, therefore it is good to introduce a new row for this parameter.  We will also need parameters for AGC3 and AGC4. “Transmit antenna gain (dBi)” is a little too vague in the current table. We suggest that we replace this with AGC3 and AGC4.  Note that AGC2 is included in MCL but not AGC3. It is therefore important to separate AGC2 from AGC3. |
| vivo | Alt 2 |  |
| InterDigital | Alt 2 |  |
| China Telecom | Alt 2 | The figure is illustrated for antenna gain including component 1,2,3 and 4 for TDL opt1. And component 4 is not included in antenna array gain, which can be shown in row (4) and (11) in the link budget template. |
| CMCC | Alt 2 | From our understanding, FL’s proposal is for the clarification on whether to include the component 4 into antenna array gain.  How to incorporate the component 3 and 4 and reflect the implementation impact should be discussed in another thread. |
| OPPO | Alt 2 |  |

**Summary of the discussion**

* 11 companies are OK for alt.2
  + 1 company mentioned a new row for antenna component 2 is necessary
  + 4 companies mentioned that (4) and (11) needs to be kept in the link budget table for antenna gain component 4
* 1 company proposed another alternative, i.e. alt 2’
  + Antenna gain components 3 and 4 are NOT included in antenna array gain
  + In this case Antenna gain components **3 and 4** corresponds to row No.(4) for transmitter, and row No.(11) for receiver in IMT-2020 link budget template, respectively.
* 1 company asked to have further clarification on the relationship between the antenna gain component and link budget table
  + For component 1: this should be included in LLS
  + For component 2: a new row is added in the link budget template
  + For component 3 and 4, they are included in Transmit antenna gain (dBi) and the name should be replaced.

In addition, there is no clear agreements on the definition of the gain of antenna gain component X. Given the companies view above, moderator would like to propose the following:

**Moderator’s updated proposal**

Further clarify the agreement on antenna gain and antenna gain components (AGC) as follows:

* For TDL option 1 (table A below) and TDL option 2 & CDL (table B below)
  + The gain of AGC 1 is included in LLS results
  + The gain of AGC 2 is included in link budget template
    - A new row is added for this purpose
    - The gain is expressed by 10 \* log 10( N/k )
    - For TDL option 2 & CDL, the gain is 0
  + The gain of AGC3 is included in link budget template
    - The gain is expressed by 10 \* log 10( M/N )
  + The gain of AGC4 is included in link budget template
  + Choose one from the following alternative
    - Alt X:
      * For Tx, One row is used represent the gain of AGC 3 + AGC 4, i.e. row No. (4)
      * For Rx, One row is used represent the gain of AGC 3 + AGC 4, i.e. row No. (11)
    - Alt Y:
      * For Tx, two rows are used to represent the gain of AGC 3 and AGC 4, respectively: i.e. one new row for AGC 3, and row No.(4) for AGC 4
      * For Rx, two rows are used to represent the gain of AGC 3 and AGC 4, respectively: i.e. one new row for AGC 3, and row No.(4) for AGC 4
* Note: how to reflect these agreements to link budget template (including the name of row) is separately discussed under section 2.16.
* Note: correction for antenna gain is separately discussed under section 3.3



Table A. antenna gain components for TDL option 1



Table B. antenna gain components for TDL option 2 and CDL

Companies are invited to input their view on this issue.

|  |  |  |
| --- | --- | --- |
| Company | Preferred alt. | Comment |
| Ericsson | Alt. X.  The use of  and 2 should also be agreed here, with details TBD in section 3.3 | Minor comment ‘AGC’ can be confused with ‘automatic gain control’. Perhaps ‘AG’ or something else might be used.  Alt. Y can’t take into account when the UE is not in the boresight of the fixed antenna pattern: 2 is a single value. That is, components 3 and 4 form a fixed antenna pattern of an array of antenna elements, and 2 reflects this pattern. So we prefer Alt. X.  Also, it is essential to account for realistic antenna gain values, and so we ask that 1 and 2 are agreed to be used in this proposal. If companies feel strongly to only have one  value, we are open to discuss this, but feel it will make companies’ assumptions less clear, as discussed in section 3.3  **Proposal:**   * + Impairment factors are introduced to reduce antenna gain, 1 for AGC2 when AGC2>0, and 2 for AGC3 and/or AGC4.     - FFS if these are included in the AGC values or on separate rows. |
| Qualcomm |  | Agree with Ericsson above. Okay to go with Alt X. We can address correction factors in 3.3, but I think email from Nokia has brought a lot of clarity already. |

**Summary of the discussion**

* 2 companies support alt X, i.e. Impairment factors are introduced to reduce antenna gain, Δ1 for AGC2 when AGC2>0, and Δ2 for AGC3 and/or AGC4.
  + FFS if these are included in the AGC values or on separate rows.
* 1 company mentioned that AGC should not be used to avoid the confusion (with automatic gain control)

To incorporate their views, moderator would like to propose the following. Note as pointed out by these companies, this discussion is closely related to antenna gain correction in section 3.3. The proposal in that section is also incorporated.

**Moderator’s further updated proposal**

Further clarify the agreement on antenna gain and antenna gain components including antenna gain correction factors as follows:

* For both TDL option 1 (table A below) and TDL option 2 & CDL (table B below)
  + The gain of antenna gain component 1 is included in LLS results
  + The gain of antenna gain component 2 is included in link budget template
    - The gain is expressed by 10 \* log 10( N/k ) - 1
    - For TDL option 2 & CDL, the gain is 0 dB
  + The gain of antenna gain component 3 is included in link budget template
    - The gain is expressed by 10 \* log 10( M/N ) - 2
  + The gain of antenna gain component 4 is included in link budget template
    - For Tx, One row is used represent the gain of antenna gain component 3 + 4, i.e. row No. (4)
    - For Rx, One row is used represent the gain of antenna gain component 3 + 4, i.e. row No. (11)
  + Antenna gain correction factors 1 and 2 are used for the following purpose:
    - 1
      * broadcast/unicast differentiation
      * account for non-ideal beamforming/combining due to imperfect channel estimation
      * This has an impact on MCL, MIL and MPL
    - 2
      * account for UE’s angular location in reference to the gNB antenna panel, e.g., aligned with analogue beam bore-sight or not;
      * This has an impact on MIL and MPL
* Note: how to reflect these agreements to link budget template (including the name of row) is separately discussed under section 2.16.
* 
* Table A. antenna gain components for TDL option 1
* 
* Table B. antenna gain components for TDL option 2 and CDL

Companies are invited to input their view on moderator proposal.

|  |  |  |
| --- | --- | --- |
| Company | Preferred alt. | Comment |
| Qualcomm |  | Support. Thanks a lot for putting this together. Gives great clarity. |
| CMCC |  | Support in principle. And thanks for including antenna gain correction factors here.  A minor comment for the part below,   * + The gain of antenna gain component 4 is included in link budget template     - For Tx, One row is used represent the gain of antenna gain component 3 + 4, i.e. row No. (4)     - For Rx, One row is used represent the gain of antenna gain component 3 + 4, i.e. row No. (11)   Could we add a new row for the component 3, since the original row (4) and (11) is named as “antenna gain”, which could be interpreted as antenna element gain directly. Alternatively, more explaination should be added to illustrate contents of those rows. |
| Ericsson |  | I don’t see any alternatives, so I didn’t select one 😊.  **The moderator’s proposal looks good overall, but should be clarified with respect to D2:**  **D2, should either be applied to a combination of antenna gain components 3 and 4, or split into a separate row**. Components 3 and 4 combine to form a fixed pattern, and so D2 applies to the combination, not the individual components. **Suggest**:   * + ~~The gain of antenna gain component 3 is included in link budget template~~     - ~~The gain is expressed by 10 \* log 10( M/N ) - 2~~   + The gain of antenna gain components 3 and 4 ~~is~~ are included in link budget template     - The gain is expressed by 10 \* log 10( M/N ) - 2     - For Tx, One row is used represent the gain of antenna gain component 3 + 4, i.e. row No. (4)     - For Rx, One row is used represent the gain of antenna gain component 3 + 4, i.e. row No. (11)   **Also, we think D2 can be affected by broadcast/unicast differentiation:** gNB implementations may choose to use different antenna patterns / virtualization for sector-wide beams vs. UE specific beams. **Suggest:**   * + Antenna gain correction factors 1 and 2 are used for the following purpose:     - 1       * broadcast/unicast differentiation       * account for non-ideal beamforming/combining due to imperfect channel estimation       * This has an impact on MCL, MIL and MPL     - 2       * broadcast/unicast differentiation       * account for UE’s angular location in reference to the gNB antenna panel, e.g., aligned with analogue beam bore-sight or not;       * This has an impact on MIL and MPL |

## Stable - [M] Open issue No.5 – other parameters for PDSCH (FR1 only)

Open issue No.5 is about the simulation assumption for PDSCH. FFS is given here, but it is not clear what needs to be added here.

* For link level simulation, adopt the following table for PDSCH for FR1.

|  |  |
| --- | --- |
| Parameters | Values |
| Other parameters | FFS |

Companies are invited to propose parameters and their values, if any.

|  |  |
| --- | --- |
| Company | Comment |
| China Telecom | Other parameters are reported by companies. |
| ZTE | Share with China Telecom. |
| Panasonic | We agree to China Telecom’s comment. |
| Intel | We share similar view as China Telecom. |
| NTT DOCOMO | We agree with the comment by China Telecom. |
| Ericsson | Will check further in the week and see if there is something missing that would benefit from aligning upon. |
| InterDigital | We support the proposal from China Telecom. |
| Vivo | Since PDSCH is less likely to be a bottleneck channel, we agree CTC that the detailed parameters can be reported by companies. |
| Samsung | Fine with China Telecom’s comment and we can simply remove the row for ‘Other parameters’. |
| Apple | We need to give the reference MCS and PRB number just like the PUSCH, otherwise the derived required SNR are quite diverse from different companies. |
| CMCC | Other parameters could be reported by companies |

**Summary of the discussion:**

* 9 companies mentioned that other parameters are reported by companies.
* 1 company proposed to wait until the end of this week to see if there is something missing.
* 1 company proposed that a guidance on MCS and PRB number is necessary.

Given the fact that this discussion is neither super-controversial nor super-urgent, the moderator proposal is updated as follows.

**Moderator’s updated proposal:**

* For PDSCH parameter(s), check further until 8/26 if:
  + there is something to be captured
  + MCS and PRB number is needed
* If nothing is identified, other parameters are reported by companies.

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Fine with moderator’s updated proposal |
| Nokia/NSB | Fine with the updated proposal |
| Intel | We are fine with moderator’s updated proposal |
| vivo | We are fine with the moderator’s proposal, the PDSCH parameters can be reported by companies |
| OPPO | Fine with moderator’s updated proposal |

**Summary of the discussion:**

* Toward the formal check on 8/26, only one potential issue was identified:
  + Reference MCS and PRB number

Note that the issue on Reference MCS and PRB number for PDSCH is also proposed in section 3.8. However, no company provided their views on this aspect, and hence it is not expected to get a big support for it. Therefore, moderator would like to propose the following.

**Moderator’s updated proposal:**

* For PDSCH, other parameters are reported by companies.

Please input your view on the moderator proposal, especially if you have a concern.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | OK with the proposal |
|  |  |

**Summary of the discussion:**

Given no negative comments, moderator would like to ask formal approval this proposal

**Moderator’s proposal:**

* For PDSCH, other parameters are reported by companies.

## Stable - [M] Open issue No.6 – DMRS for PUSCH (FR1 only)

Open issue No.6 is a DMRS configuration for PUSCH, which is currently a working assumption.

* For link level simulation, adopt the following table for PUSCH for eMBB data or VoIP for FR1.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| DMRS configuration for PUSCH | …  Working assumption:  For 3km/h: Type I, 1 or 2 DMRS symbol, no multiplexing with data. |

According to the contributions in this meeting, there seems to be no proposal to overturn this working assumption. Therefore, moderator would like to propose the following:

**Moderator’s proposal**

* Confirm the working assumption on DMRS configuration for PUSCH:
  + For 3km/h: Type I, 1 or 2 DMRS symbol, no multiplexing with data.

Interested companies are invited to input your views on this proposal. Note that from moderator point of view, changing working assumption is discouraged for our progress.

|  |  |
| --- | --- |
| Company | Comment |
| China Telecom | Support confirming the working assumption on DMRS configuration for PUSCH for FR1. |
| OPPO | For 3km/h:   * If the chosen MCS is same for 1 and 2 DMRS symbol: Type I, 2 DMRS symbol, no multiplexing with data.   If the chosen MCS is different: Type I, 1 DMRS symbol, no multiplexing with data. |
| CATT | Support FL’s proposal. |
| ZTE | Support the proposal.  When the number of DMRS symbols is different, the chosen MCS may be different. In our contribution, we find that using one DMRS could result in a lower MCS in some cases, which will provide a better performance. In case the MCS is the same with one or two DMRS, the performance with assuming two DMRS is better. Thus, both one or two DMRS symbols could be considered. |
| Panasonic | We support the moderator’s proposal. |
| Nokia/NSB | All the results we have seen in contributions seem to be based on the working assumption. Support. |
| Intel | We are fine to confirm the working assumption. |
| NTT DOCOMO | We are fine with FL proposal, and if we will define a single number for DMRS symbol, we support to use 1 DMRS symbol for 3km/h. |
| Ericsson | From what we have seen so far, the working assumption is fine. However, we are open to other configurations if they can be shown to be better baselines. |
| Qualcomm | While we are okay with the proposal, we think 1 DMRS symbol is insufficient. We need at least 2 DMRS symbols at low SNR. We also have to contend with practical aspects like frequency errors. |
| InterDigital | We support the proposal from the FL. |
| Vivo | Agree with the proposal. DMRS symbols can be 2 when considering frequency hopping, otherwise can be 1. |
| Samsung | Fine with moderator’s proposal. Prefer 1 DMRS symbol for comparison across companies |
| Sharp | We are OK with FL proposal. |
| Apple | We agree the FL’s proposal. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Support the proposal |
| CMCC | We are fine with FL proposal.  2 DMRS symbols is assumed for 3km/h within our LLS, which is same as our deployment. |
| Huawei, Hisilicon | Support the moderator’s proposal |

**Summary of the discussion:**

* 16 companies are fine to confirm the working assumption.
* 5 companies discussed which number of DMRS symbols to use, 1 symbol or 2 symbols.

For the second point of discussion, it seems that companies have different opinion on which number of DMRS symbols can achieve higher performance. Given the limited time for study item completion and the number of open issues, we should avoid consuming time on this topic. Thus moderator would like to propose the following:

**Moderator’s updated proposal:**

* Confirm the working assumption on DMRS configuration for PUSCH:
  + For 3km/h: Type I, 1 or 2 DMRS symbol, no multiplexing with data.
* The number of DMRS symbols is reported by companies

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| InterDigital | We support the moderator’s updated proposal |
| Samsung | Support |
| Nokia/NSb | Support |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Support the proposal |
| Intel | We are fine with moderator’s updated proposal |
| vivo | Support moderator’s proposal |
| OPPO | Support moderator’s updated proposal |

**Summary of the discussion:**

* 7 companies are OK for the moderator’s proposal

Therefore, moderator would like to propose the following for approval:

**Moderator’s updated proposal:**

* Confirm the working assumption on DMRS configuration for PUSCH:
  + For 3km/h: Type I, 1 or 2 DMRS symbol, no multiplexing with data.
* The number of DMRS symbols is reported by companies

## Open but looks stable - [L] Open issue No.7 – Repetition type B for PUSCH (FR1 only)

Open issue No.7 is about repetition type B for VoIP for PUSCH.

|  |  |
| --- | --- |
| Repetitions for PUSCH | For VoIP, w/ repetition.  The actual number of repetitions is reported by companies.  FFS: Repetition type B |

One contribution discusses this issue, and proposes NOT to employ Repetition type B [5] because no performance benefit is foreseen.

Interested companies are invited to input your views on the necessity of repetition type B.

|  |  |
| --- | --- |
| Company | Comment |
| China Telecom | Companies can report repetition type for PUSCH. |
| CATT | We don’t think PUSCH type B is a typical case for coverage enhancement. PUSCH repetition type B pursue low latency instead of better coverage. |
| ZTE | The PUSCH duration is agreed as 14 symbols in LLS. In such case, there is no performance difference between different repetition types. Thus, no need to consider PUSCH repetition Type B specifically for simulation purpose. Of course, it doesn’t mean we will not consider Type B PUSCH in enhancement techniques discussion. |
| Panasonic | We agree to China Telecom’s comment. |
| Nokia/NSB | Fine with not considering repetition type B. |
| Intel | Given that PUSCH duration of 14 symbols is assumed in the link level simulations, we do not see the need to consider PUSCH repetition type B. In our view, PUSCH repetition type A would be sufficient. |
| NTT DOCOMO | We defined to use 14 symbols for PUSCH and DDDSU for TDD pattern, so that it may be hard to apply type B repetition. |
| Ericsson | If Rel-16 repetition type B provides the best coverage, it can be a baseline. Whether repetition type B is enhanced should be discussed under another agenda point. |
| Qualcomm | We propose to not include this in the baseline. PUSCH repetition type B was proposed for URLLC in the context of latency reduction. We don’t think it is useful here. |
| InterDigital | We support the proposal from China Telecom. Companies can report whether repetition type A or B is used. |
| Vivo | We suggest to use Type-A PUSCH repetition for voip. We do not see strong need to use type-B reprtition. If type B means occupying all UL resource for PUSCH, and it will affect other UL channels transmission; otherwise, type-A PUSCH repetition is more realistic for voip. |
| Samsung | Support China Telecom’s comment, i.e., company can report. It is desirable to utilize the available UL resources in flexible slot of TDD system in the context of coverage enhancement. |
| Sharp | We assume the proposal is for baseline performance evaluation. We are OK with FL proposal. |
| Apple | Company can report the repetition type for VoIP, but repetition type B is not the baseline. |
| Huawei, Hisilicon | For 14OS scheduling as evaluation baseline, whether Type A or Type B PUSCH scheduling makes no big difference. |

**Summary of the discussion:**

* 5 companies mentioned that companies can report which type to be used.
* On the other and 8 companies thinks that repetition type B is neither helpful/useful nor baseline evaluation.
* 1 company views that repetition type B can be the baseline if it can achieve the best performance

Given the situation above, we can foresee the situation that most of the companies submit the simulation result using type A repetition. Therefore, the moderator doesn’t see the strong need to keep type B repetition, and would like to propose the following:

**Moderator’s updated proposal:**

* Update the description on Repetitions for PUSCH as follows:
  + For VoIP, w/ type A repetition. (optional for type B repetition)  
    The actual number of repetitions is reported by companies.  
    ~~FFS: Repetition type B~~

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Fine with moderator’s updated proposal |
| Nokia/NSB | Fine with moderator’s proposal. We would be also fine if the part “optional for type B repetition” was dropped. |
| Intel | We are fine with moderator’s updated proposal |
| vivo | Support moderator’s proposal |
| OPPO | Support moderator’s updated proposal |
| Ericsson | OK |

## Open but looks stable - [L] Open issue No.8 – BLER for CSI (FR1 only)

Open issue No.8 is about BLER for PUCCH for CSI, i.e. 10% or 1%.

|  |  |
| --- | --- |
| BLER for PUCCH | …  FFS: BLER for CSI (10% or 1%) |

One contribution discusses this issue, and proposes not to perform evaluations for CSI [5].

Interested companies are invited to input your views on BLER for CSI (10% or 1%) as well as the necessity of evaluation for CSI on PUCCH itself.

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | It’s sufficient to only evaluate the HARQ-ACK performance, which is more important and requires more stringent requirement, e.g., 0.1% for NACK to ACK probability. |
| Nokia/NSB | Studying PUCCH coverage for relaxed BLER target in case of CSI feedback may need significant additional work for the AI. Intuitively, one would expect that such relaxation could only result in better MPL/MCL for PUCCH. On the other hand, assessing the impact of less accurate CSI at gNB on MCL/MPL of DL channels would not be so straightforward. For instance, this may affect the way antenna array gain for PDSCH and unicast PDCCH would look like, as compared to the 1% BLER counterpart. Different gNB implementations may also handle this case differently. Other implications may exist. We would agree with the proposal in [5]. |
| Intel | We prefer 1% for CSI on PUCCH. |
| Ericsson | We find that CSI is one of the bottlenecks even with 11 bits and 10% BLER. Note that HARQ-ACK can be repeated, whereas A-CSI cannot. CSI does not change so frequently, and so a 10% BLER may be sufficient in coverage limited scenarios. On the other hand, we have no objection to reporting both 10% and 1%, since this is simple to simulate. |
| Qualcomm | We prefer to evaluate PUCCH at the 1% BLER target for all cases. Reliable CSI can be critical to a cell-edge UE and even a short duration where CSI is not available can lead to link failure. |
| Vivo | We suggest not to associated the target BLER with UCI type. Since the HARQ-Ack and CSI may also multiplex on the PUCCH resource for CSI report, e.g. PF3 with 22 bits, the target BLER should still be 1%. |
| Samsung | Prefer 1% BLER. This is in line with current RAN4 requirements. |
| Sharp | We prefer 1% BLER for CSI. 10% BLER should be for transmission with HARQ. |
| Huawei, Hisilicon | Baseline simulation for PUCCH with CSI BLER=10% should still be performed. Compared to PUCCH with small payload size such as 1 or 2bits in Format0 or 1 with BLER=1% which only carries ACK/NACK or SR, the performance of a larger payload size of PUCCH with CSI might be worse even at BLER=10%. |

**Summary of the discussion:**

* 2 companies mentioned that there is no strong need to perform evaluation for CSI
* 5 companies are interested in 1% BLER for CSI on PUCCH
* 1 company sees the necessity for 10% BLER for CSI on PUCCH for certain scenarios.

From the discussion above, majority of companies are interested in the evaluation for CSI on PUCCH, which BLER is 1%. 10% BLER should be treated as low priority considering the number of interested companies.

**Moderator’s updated proposal:**

* Update the row for BLER for PUCCH as follows:
  + ~~FFS:~~ BLER for CSI (~~10% or~~ 1%, (optional for 10%) )

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Fine with moderator’s updated proposal |
| Nokia/NSB | Fine with moderator’s updated proposal |
| Intel | We are fine with moderator’s updated proposal |
| vivo | Support moderator’s proposal |
| OPPO | Support moderator’s updated proposal |
| Ericsson | We can accept the proposal as a compromise. |

## Stable - [M] Open issue No.9 – gNB receive chains in LLS for TDL (FR1 only)

Open issue No.9 is gNB modelling in LLS for TDL. Two options are captured in the simulation assumption table.

|  |  |
| --- | --- |
| Number of ~~receive~~ TxRUs for BS | ~~[~~gNB odelling in LLS for TDL:   * Option 1: 2 or 4 gNB receive chains in LLS ~~(as starting point)~~. FFS: correlation * Option 2: Number of gNB receive chains = number of TXRUs in LLS. FFS: correlation.~~]~~ |

The FFS part for this parameter, i.e. correlation, should be solved. In addition, there are proposals to choose one option [2, 5, 22] from them. Companies are invited to input their views on correlation and the choice of option.

|  |  |
| --- | --- |
| Company | Comment |
| China Telecom | We prefer Option 1 to reduce the simulation burden. |
| OPPO | We prefer Option 1.  It can reduce the simulation burden if obtain the antenna gain which mapping from chains to TxRU in the link budget template. |
| CATT | Option1. |
| ZTE | Option 1 is preferred. Correlation is only needed in case of high number of RF chains is assumed for TDL channel. Thus, no need to consider the correlation for Option 1. |
| Panasonic | Option 1 is preferred to simplify the link level evaluation. The correlation (gain) can be modelled as 10\*log(NTXRUs/NRx), where NTXRUs is the number of TXRUs and NRx is the number of gNB receive chains in LLS. |
| Nokia/NSB | Option 1. No correlation considered given the low number of receive chains. |
| Intel | We prefer Option 1. As for TDL channel model, 2 or 4 gNB receive chains in LLS is sufficient for link level simulation. |
| Ericsson | Option 1. Medium correlation can be used to improve accuracy, especially for the 4 Rx antenna case. |
| Qualcomm | Option 2 is our preference since it leads to realistic link modelling. For Option 2, we can go with “low correlation”. |
| InterDigital | We support Option 1. |
| Vivo | We prefer option 1, especially considering the simulation workload. In TDL, only 2 or 4 ports in LLS would greatly reduce the simulation effort. |
| Samsung | Option 1 |
| Apple | Option 1 is preferred. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Option 1. |
| Huawei, Hisilicon | We prefer Option1 in baseline evaluation with considerable simulation workload. |

**Summary of the discussion:**

* 14 companies support option 1 to reduce the simulation workload
  + 1 company proposes to employ medium correlation
  + 2 company proposes to employ no correlation
* 1 company support option 2
  + 1 company proposes to employ low correlation

Based on the companies input, we see clear majority for option1. On the other hand, there are less number of input for the preferred correlation. Moderator would therefore like to propose the following.

**Moderator’s updated proposal:**

|  |  |
| --- | --- |
| Number of TxRUs for BS | gNB odelling in LLS for TDL:   * ~~Option 1:~~ 2 or 4 gNB receive chains in LLS. ~~FFS:~~ correlation is reported by companies * ~~Option 2: Number of gNB receive chains = number of TXRUs in LLS. FFS: correlation.~~ |

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| InterDigital | We support the moderator’s updated proposal. If it helps to improve alignment of the results among companies and reduce simulation load, we are also fine to restrict correlation, e.g., medium correlation for 4 gNB receive chains and low correlation for 2 gNB receive chains. |
| Samsung | Support |
| Nokia/NSB | We propose to rephrase “correlation is reported by companies” as “Companies can report if and how correlation is modelled”. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Support the proposal |
| Intel | We are fine with moderator’s updated proposal |
| Qualcomm | This change is not acceptable to us. We are the only company willing to run full-fledged LLS with 64 TXRUs. Please retain Option 2 as is, with low correlation.  We don’t think simulations with 2 or 4 gNB TXRUs accurately reflect the performance of TDD MMIMO deployments. I think there was some interest from operators to run more realistic simulations rather than making overly simplistic assumptions.  Let me also remind other companies that the methodology they have adopted has so far not been technically justified. |
| Vivo | Support moderator’s proposal |
| OPPO | Support moderator’s updated proposal |

**Summary of the discussion:**

* 7 companies are OK for moderator’s proposal
  + 1 company proposed to rephrase the proposal : i.e.“correlation is reported by companies” as “Companies can report if and how correlation is modelled”
  + 1 company mentioned that restricting the correlation is good to reduce the simulation load and alignment among companies’ result.
* 1 company has a concern to remove option 2
  + The company is strongly willing to run the simulation with full-fledged LLS with 64 TXRUs

Recall the 1st round discussion, the concern to option 2 is the workload. Given the analysis above, the following is a good proposal for way forward.

**Moderator’s updated proposal:**

|  |  |
| --- | --- |
| Number of TxRUs for BS | gNB modelling in LLS for TDL:   * ~~Option 1:~~ 2 or 4 gNB receive chains in LLS. ~~FFS:~~ * Optional ~~Option 2~~: Number of gNB receive chains = number of TXRUs in LLS~~. FFS: correlation.~~ * Companies can report if and how correlation is modelled |

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Support Moderator’s proposal. |
|  |  |

**Summary of the discussion:**

Given no concern from companies, moderator would ask formal approval on this proposal:

**Moderator’s proposal:**

|  |  |
| --- | --- |
| Number of TxRUs for BS | gNB modelling in LLS for TDL:   * ~~Option 1:~~ 2 or 4 gNB receive chains in LLS. ~~FFS:~~ * Optional ~~Option 2~~: Number of gNB receive chains = number of TXRUs in LLS~~. FFS: correlation.~~ * Companies can report if and how correlation is modelled |

## Stable - [M] Open issue No.10 – gNB receive chain in LLS for CDL (FR1 only)

Open issue No.10 is gNB architecture & modelling for CDL.

|  |  |
| --- | --- |
| Number of ~~receive~~ TxRUs for BS | [gNB architectures to study for CDL:   * Urban: 64 receive chains for 2.6 and 4 GHz in LLS * Rural: 8 receive chains for 4GHz and 2.6GHz in LLS * 4 receive chains for 2GHz and 700MHz in LLS.]   [gNB odelling in LLS for CDL:   Number of gNB receive chains = number of TXRUs in LLS.] |

This issue is related to open issue No.2 (necessity of CDL for LLS), the necessity of this bullet depends on the decision of open issue No.2.

**Moderator’s proposal**

* If necessity of CDL for LLS is agreed under open issue No.2, remove the square bracket.
* Otherwise, remove the whole bullets about gNB architectures to study for CDL and gNB odelling in LLS for CDL

Interested companies are invited to input your views on this moderator’s proposal.

|  |  |
| --- | --- |
| Company | Comment |
| CATT | It is related to No.2 issue. As we agree with FL’s proposal on No.2 issue, we think the whole bullets can be removed and the antenna configuration can be reported by the interested companies. |
| ZTE | Fine with the proposal. |
| Panasonic | We support the moderator’s proposal. |
| Intel | We are fine with FL’s proposal. |
| Ericsson | Suggest to wait until issue 2 is decided. Then if there are results using CDL that we wish to capture in the TR (not necessarily in the link budget templates), we can do so. |
| Qualcomm | Since we are focusing on TDL channel model, we think this is not necessary. |
| InterDigital | We support the proposal from the FL. |
| Vivo | We agree with moderator’s proposal. |
| Samsung | Remove the whole bullets |
| Apple | We support FL’s proposal. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Support the proposal |
| Huawei, Hisilicon | TDL channel model in LLS is preferred |

**Summary of the discussion:**

* 11 companies are fine to remove this row, if it is concluded under open issue No.2 discussion that CDL is not used to generate results in the link budget templates
* 1 company want to keep it to capture in the TR

Judging form the discussion above, it is less likely that the company use CDL for their evaluation. Therefore, to address the concern from the CDL proponent, moderator would propose the following.

**Moderator’s updated proposal:**

* Wait for the decision on open issue No.2 until 8/26
  + If necessity of CDL for LLS is agreed under open issue No.2, remove the square bracket.
  + Otherwise, remove the whole bullets about gNB architectures to study for CDL and gNB odelling in LLS for CDL
  + Note: if CDL is used for link level simulation for a certain purpose, the assumption for the number of TxRUs for BS is reported by companies, which implies that the assumption will be captured in the TR.

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| InterDigital | We support the moderator’s updated proposal |
| Samsung | OK with moderator’s updated proposal |

**Update on 8/24**

Since it was agreed to delete CDL for Channel model for link-level simulation, The moderator proposal is updated as follows:

**Moderator’s updated proposal:**

* Remove the whole bullets about gNB architectures to study for CDL and gNB odelling in LLS for CDL
* Note: if CDL is used for link level simulation for a certain purpose, the assumption for the number of TxRUs for BS is reported by companies, which implies that the assumption will be captured in the TR.

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Support |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Support the proposal |
| Intel | Support |
| vivo | Support moderator’s proposal |
| InterDigital | Support |
| OPPO | Support moderator’s updated proposal |

**Summary of the discussion.**

Since there is no concern on the moderator proposal, moderator would like to ask a formal approval for this proposal.

**Moderator’s proposal:**

* Remove the whole bullets about gNB architectures to study for CDL and gNB modelling in LLS for CDL
* Note: if CDL is used for link level simulation for a certain purpose, the assumption for the number of TxRUs for BS is reported by companies, which implies that the assumption will be captured in the TR.

## Open but looks stable - [L] Open issue No.11 – PDSCH duration for Msg.4 (FR1 only)

Open issue No.11 is about the link level simulation for Msg.4 PDSCH.

* For link level simulation, for PDSCH of Msg.4 for FR1.
  + Reuse the following simulation assumption for PDSCH
    - Waveform, [PDSCH duration]

RAN1 should discuss whether to simply delete this square bracket, or apply different duration from normal PDSCH. Considering the fact that no contribution discusses this issue in this meeting, the following proposal can be made.

**Moderator’s proposal**

* The same PDSCH duration as PDSCH is used for Msg.4 PDSCH (i.e. remove the square bracket)

Companies are invited to provide their view on this proposal.

|  |  |  |
| --- | --- | --- |
| Company | Agree to remove square bracket [Y/N] | Comment |
| ZTE | Yes | We are fine with the proposal. |
| Panasonic | Yes |  |
| Intel | Yes | We are fine with FL’s proposal. |
| Ericsson | Yes | Our understanding is that this does not preclude Msg4 retransmission as a baseline. |
| vivo | Y | We agree with moderator’s proposal |
| Samsung | Yes |  |
| Sharp | Yes |  |
| Apple | Yes | We agree with FL’s proposal |
| Huawei, Hisilicon | Yes | Evaluation observations show the downlink data channel is not the coverage bottleneck, but OK with the proposal. |

**Summary of the discussion:**

* All the companies participate this discussion support the moderator proposal

Therefore, the moderator proposal remains unchanged.

**Moderator’s updated proposal:**

* The same PDSCH duration as PDSCH is used for Msg.4 PDSCH (i.e. remove the square bracket)

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Support |
|  |  |

**Moderator’s further updated proposal:**

Since one comment from a company has missed, the moderator proposal is updated as follows:

* The same PDSCH duration as PDSCH is used for Msg.4 PDSCH (i.e. remove the square bracket)
  + Note: this does not preclude Msg4 retransmission as a baseline.

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | OK |
| Intel | Support |
| vivo | Support moderator’s proposal, suggestion on a minor revision in note as below  Note: this does not preclude Msg4 with retransmission as a baseline. |
| Ericsson | Support |

## Discussion needed - [L] Open issue No.12 – Payload size for Msg.4 (FR1 only)

* For link level simulation, for PDSCH of Msg.4 for FR1.
  + FFS: Payload size: [3000bits].

According to the contributions in this meeting, no specific value other than 3000 bits was proposed. The following moderator proposal can therefore be made.

**Moderator’s proposal**

* **Adopt 3000 bis for Msg.4 PDSCH payload size (i.e. remove the square bracket) .**

Companies are invited to provide their view on this proposal.

|  |  |  |
| --- | --- | --- |
| Company | Agree to adopt 3000bits [Y/N] | Comment |
| ZTE | Yes | Would be fine for us. BTW, a typo ‘bis’ to ‘bits’. |
| Panasonic | Yes |  |
| Intel | Yes | We are generally fine with the proposal. One minor comment: 3000 bits are not valid TBS. We can use 2976 bits for TBS in the simulation. |
| Ericsson | No | We gave a look at values used in networks and think 130 bytes is more representative. Can someone explain where 3000 bits comes from? |
| Qualcomm | Disagree | 3000 bits is a little on the higher side. In our paper, we have assumed 130 bytes to align with evaluations being conducted under Redcap coverage recovery. |
| Vivo | Y | We agree with moderator’s proposal |
| Huawei, Hisilicon | Y | OK |

**Summary of the discussion:**

* 5 companies are OK to adopt 3000 bits for Msg.4 PDSCH payload size
* 2 companies think 3000-bits is bigger than their thought. Instead 130 bytes (=1040 bits)

Given this situation, it is not easy to make a way forward for this issue. Moderator would encourage further discussion on this.

**Moderator’s updated proposal:**

* More discussion is necessary which value (3000 bits vs 1040 bits) is more appropriate
  + Especially for the reason why 3000 bits is deemed as appropriate. Proponents are encouraged to provide their view.
* After that, choose one option for Msg.4 PDSCH payload size from the following:
  + Option 1: 3000 bits
  + Option 2: 1040 bits
  + Option 3: 3000 bits or 1040 bits (Company can report which one to be used)

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | Option 2 |
| vivo | Option 1 |
| Ericsson | Option 2. We would like to know what content there is that requires 3000 bits. Again, the size we are aware of in deployment is roughly 130 bytes. |

## Final confirmation - [M] Open issue No.13 – VoIP packet size (FR1 only)

Open issue No.13 is about the packet size for VoIP.

* For VoIP performance evaluation based on link-level simulation for FR1.
* A packet size of **[320]** bits with 20ms data arriving interval is adopted.

[3] gives a very detailed proposal on this: AMR-WB 12.65 (kbit/s) for VoIP evaluations, which corresponds to 352 bits packet size.

|  |  |
| --- | --- |
|  | **Size (bits)** |
| Payload | 264 |
| CRC | 16 (TBS size lower than 3824 bits) |
| MAC | 16 (with 12 bits SN size) |
| RLC | 8 (with 6 bits SN size) |
| PDCP | 16 |
| RTP/UDP/IP | 32 (w RoHC) |

Thus, the necessary discussion in RAN1#102e is which payload size to adopt, 320 bits or 352 bits (or any other value).

|  |  |  |
| --- | --- | --- |
| Company | Preferred bit size 320, 352 or something else | Comment |
| China Telecom | 320 | We prefer 320bits, i.e. remove the brackets. |
| OPPO | 320 | The enhancement is about the coverage on top of baseline. It does not make much different by slightly different payload , in regards of coverage improvement.  Even for the absolute MCL comparing to UTRA, the 12.2 would be more appropriate. |
| CATT | 320 |  |
| ZTE | 320 | As discussed in R1-070674 in LTE, 320 bits payload size is assumed. Given there is no big difference to the other proposed value, it would be ok for us to choose either value. |
| Panasonic | Either 320 or 352 |  |
| Nokia/NSB | 352 (soft preference) | We prefer 352 bits, given the arguments we presented in our contribution [5]. |
| Intel | 320 | We prefer 320 bits for VoIP. |
| Ericsson | 320 | Exact value is not crucial. However, this value seems to imply that HARQ is used. Can this be clarified? |
| Qualcomm | Proposed packet components and their sizes are okay, but do not specify TB size. | We are in principle okay to go with Nokia proposal. We however don’t want this to be translated to TB size as we can potentially segment this payload. We can capture the table as is, and say TB size is to be derived based on this table depending on assumptions on segmentation. |
| InterDigital | 320 |  |
| vivo | 320 | We prefer TBS=320 bits with 20ms arrival interval in simulation. |
| Samsung | 320 | Also fine with 352 bits |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | 320, 160 | 320 is OK for full rate speech.  We are also interested to see under extreme coverage conditions whether less-than full rate codecs can provide additional coverage. |
| Huawei, Hisilicon | A larger TBS should be further discussed | 320bits @20ms data arrival interval only reflects an ideal case because it extremely utilizes all UL slots of each 20ms period by assuming steady data arrival rate without any network jitter and full tolerance of transmission delay caused by any higher layer (e.g. RLC) retransmission with 2% MAC rBLER. Furthermore, for VoIP services, the SIP invite message which consists of additional overhead can require a higher data rate than 12.2 kbps in physical layer. |

**Summary of the discussion:**

* 11 companies are OK adopt a packet size of 320 bits with 20ms data arriving interval
* 4 companies are OK for 352 bits, but 1 company mentioned that it is not preferred to translate this to TB size.
* 1 company additionally propose 160 bits for lower rate codec for extreme coverage.

Given the situation above, 320 bits can be the baseline for our evaluation. On the other hand, 352 bits can also be considered with lower priority. For 160bits, it obviously requires more discussion because it is a new proposal.

**Moderator’s updated proposal:**

Update the agreements as follows:

* For VoIP performance evaluation based on link-level simulation for FR1
* A packet size of ~~[~~320~~]~~ bits with 20ms data arriving interval is adopted.
* The following packet component for AMR-WB 12.65 (kbit/s) is optionally adopted.

|  |  |
| --- | --- |
|  | **Size (bits)** |
| Payload | 264 |
| CRC | 16 (TBS size lower than 3824 bits) |
| MAC | 16 (with 12 bits SN size) |
| RLC | 8 (with 6 bits SN size) |
| PDCP | 16 |
| RTP/UDP/IP | 32 (w RoHC) |
|  |  |

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| InterDigital | We are ok with the updated proposal. For clarification, we can also add a note “If applicable, companies report TB size assumed in evaluation” if any TB processing is implemented/assumed in evaluation. |
| Samsung | Support |
| Nokia/NSB | We are ok with the proposal, and agree with InterDigital’s suggestion |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | 160 bits may also be captured as optional. |
| Intel | We are fine with moderator’s updated proposal |
| Qualcomm | Don’t agree. I think we need to pick one of the two. We prefer listing the components explicitly, with no reference to packet size being 320 bits.  Companies preferring 320 bits need to justify how they account for RoHC/PDCP/RLC/MAC headers. Barring a clear justification, we should go with the explicit components listed above. |
| vivo | We support moderator’s proposal on packet size 320 bits, however the packet components in the table adds to 352 bits? |

**Summary of the discussion**

* 5 companies are OK for moderator proposal.
* 2 companies want to add a note (If applicable, companies report TB size assumed in evaluation)
* 1 company want to choose one, which have explicit information on the components.
  + Note: the rationale for 320bit can be found in R1-2003338, i.e.
    - According to TR 25.912 [2], the encoder frame length of VoIP is 20ms with a total of voice payload on air interface of 320 bits (without RLC segmentation). The performance of VoIP can be improved by repetitions/re-transmissions as long as the repetitions/re-transmissions do not exceed the encoder frame length of 20 ms.
* 1 company propose to add 160 bits optional (Note: moderator wonders if 160bits is really necessary because 320bits will have worse performance anyway)

It is clear from the discussion that the best way to go is to clarify the component for 320bits packet size. The past contribution referred by ZTE (R1-070674) mention the following.

***Main parameters of the traffic model***

*The following table provides the relevant parameters of the VoIP traffic that shall be assumed in the simulations. The details of the corresponding traffic model are described below:*

|  |  |
| --- | --- |
| Parameter | Characterization |
| *Codec* | *RTP AMR 12.2,*  *Source rate 12.2 kbps* |
| *Encoder frame length* | *20 ms* |
| *Voice activity factor (VAF)* | *50% (c=0.01, d=0.99)* |
| *SID payload* | *Modelled*  *15 bytes (5Bytes + header)*  *SID packet every 160ms during silence* |
| *Protocol Overhead with compressed header* | *10 bit + padding (RTP-pre-header)*  *4Byte (RTP/UDP/IP)  2 Byte (RLC/security) 16 bits (CRC)* |
| *Total voice payload on air interface* | *40bytes (AMR 12.2)* |

Moderator wonders if the following proposal is acceptable to everyone with this clarification.

**Moderator’s updated proposal:**

Update the agreements as follows:

* For VoIP performance evaluation based on link-level simulation for FR1
* A packet size of ~~[~~320~~]~~ bits with 20ms data arriving interval is adopted.
  + Note: the detailed information on packet component is found in Appendix A of R1-070674
* The following packet component for AMR-WB 12.65 (kbit/s) is optionally adopted.

|  |  |
| --- | --- |
|  | **Size (bits)** |
| Payload | 264 |
| CRC | 16 (TBS size lower than 3824 bits) |
| MAC | 16 (with 12 bits SN size) |
| RLC | 8 (with 6 bits SN size) |
| PDCP | 16 |
| RTP/UDP/IP | 32 (w RoHC) |
|  |  |

* If applicable, companies report TB size assumed in evaluation

Please input your view on the moderator’s updated proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | **Ok with moderator’s updated proposal, although it would be good to align TBS sizes further if possible..** Our understanding is that 320 bits TBS is reasonable; unfortunately I don’t have the protocol overhead breakdown to hand, but can check. |
| Qualcomm | Lets push for alignment here. We don’t see too much difference. Only concern using R1-070674 as a reference is that it may not accurately reflect NR’s RoHC/PDCP/RLC/MAC header overhead. How about the following compromise:   |  |  | | --- | --- | |  | **Size (bits)** | | Payload | 256 | | CRC | 16 (TBS size lower than 3824 bits) | | MAC | 16 (with 12 bits SN size) | | RLC | 8 (with 6 bits SN size) | | PDCP | 16 | | RTP/UDP/IP | 24 (w RoHC) | |  |  |   Excluding CRC, TB comes to 320 bits if we don’t segment the packet. Both the changes made as justifiable as RoHC headers vary in size, and 3-4 bytes are the common size. 264 comes due to octet-alignment of the payload, and if that is not imposed, codec payload comes to 256 bits. |

**Summary of the discussion**

A compromise proposal is given by a company, which defines the packet component for 320bits.

**Moderator’s updated proposal:**

Update the agreements as follows:

* For VoIP performance evaluation based on link-level simulation for FR1
* A packet size of ~~[~~320~~]~~ bits with 20ms data arriving interval is adopted, which component is as follows:

|  |  |
| --- | --- |
|  | **Size (bits)** |
| Payload | 256 |
| CRC | 16 (TBS size lower than 3824 bits) |
| MAC | 16 (with 12 bits SN size) |
| RLC | 8 (with 6 bits SN size) |
| PDCP | 16 |
| RTP/UDP/IP | 24 (w RoHC) |
|  |  |

* The following packet component for AMR-WB 12.65 (kbit/s) is optionally adopted.

|  |  |
| --- | --- |
|  | **Size (bits)** |
| Payload | 264 |
| CRC | 16 (TBS size lower than 3824 bits) |
| MAC | 16 (with 12 bits SN size) |
| RLC | 8 (with 6 bits SN size) |
| PDCP | 16 |
| RTP/UDP/IP | 32 (w RoHC) |
|  |  |

* If applicable, companies report TB size assumed in evaluation

Please input your view on the updated proposal, especially if you have concern.

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | If there are no objections, we can drop the second table. Looks good otherwise. Okay either way. |
|  |  |

## Closed - [H] Open issue No.14 – target performance metric (FR1 & FR2 common)

Target performance metrics and values were discussed at RAN1#101e, but nothing was captured in the minute to lack of consensus. The landscape of companies’ preference is as follows: (please check if your view is correctly captured!)

* Option 1. Pathloss or MPL based
  + Alt 1. Derived from target ISD
    - [Intel], [CMCC], [Apple], [ZTE], [CTC],[CATT], [Panasonic]
  + Alt 2. Relative MPL
    - [Oppo], [CMCC], SoftBank (For eMBB, if the market/operator demand is not clear),
* Option 2. MCL or MCL based
  + Alt.1 Derived from target ISD
    - [Panasonic], [CTC]
  + Alt. 2 Fixed value
    - SoftBank (147dB for voice), [CTC (147dB for voice)], [Panasonic]
  + Alt.3 Relative MCL(/MIL)
    - [DOCOMO], [SoftBank (For eMBB, if the market/operator demand is not clear)], [InterDigital], [Qualcomm]

It is hard to say that there is a clear majority for a specific option/alternative.

From moderator perspective, all of the options/alternatives are feasible for bottleneck identification. The question is how to set the threshold, i.e.

* For ISD based approach, we need more discussion on the exact value for target and why it is chosen. In addition, its scenario dependency should also be taken into account.
* For relative approach, we need more discussion on how many bottleneck channels can be solved.
* For fixed value approach, RAN1 had a discussion on voice only. We have no guidance for eMBB.

From rapporteur point of view, the less controversial approach would be relative MPL/MCL/MIL based approach. The operators demand for specific ISD value(s) and MCL values for voice shall be taken into account when identifying the bottleneck channels requiring coverage enhancements.

**Moderator’s proposal**

* **Adopt relative MPL/MCL/MIL for target performance metric for both eMBB and VoIP**
  + **ISD value of X m for scenario Y and fixed MCL value of Z dB for VoIP shall be satisfied when identifying bottleneck channel(s) requiring coverage enhancements**
    - **(set of) X and Y are decided based on operators’ request**
    - **Z is 147dB, but it may need adjustment depending on the definition of MCL**
* **On the down selection of relative MPL/MCL/MIL:**
  + **Final decision will be made at the 2nd step discussion at RAN1#102e taking into account the definition of MPL, MCL and MIL discussed under section 3.1.**
* **On the identification of bottleneck channel(s) requiring coverage enhancements,**
  + **Final decision will be made at RAN1#103-e based on the link budget analysis**

Interested companies are invited to input your views on this moderator’s proposal.

|  |  |
| --- | --- |
| Company | Comment |
| China Telecom | From our view, we care more about what NR can achieve in term of coverage performance at present, e.g. coverage distance, as well as the gap between the baseline performance and target performance. We understand that some companies prefer MCL as the metric. Then we suggest both MCL and MPL can be the performance metric as MCL and MPL can be derived from each other. In our understanding, the absolute value can better reflect the requirements from operators. The target MCL and MPL can be derived from ISD, while ISD can be provided based on operators’ practical deployment. The typical values, e.g., 500m for urban, 1732m for rural, widely used in the simulation can be adopted. We understand that there may be the case that multiple channels cannot achieve the target. If the case happens, operators can better understand the gap between the baseline performance and the target, while the exact performance gain depends on the enhanced solutions.  Thus, we have the following proposal.  Performance metric for analysis   * Both MCL and MPL are adopted as the metric for performance analysis. * For VoIP, target MCL of 147dB or target MCL/MPL derived from typical ISD, e.g. 500m for urban and 1732m for rural, can be defined as the target performance. * For eMBB, target MCL/MPL derived from typical ISD, e.g. 500m for urban and 1732m for rural, can be defined as the target performance.   Performance metric for enhancements   * Relative MCL/MPL between different channels are adopted as the metric for enhancements. |
| OPPO | MCL is a simplified performance metric, without considering certain fading and penetration margins. We prefer the relative MPL as the target performance metric. |
| CATT | We support alt.1 which is shown in our Tdoc submitted to Others AI. Our position is updated accordingly.  From the positions shown above, alt.1 under umbrella of option 1 has the most proponents. It’s better to adopt alt.1 of option 1 as the proposal at this stage. |
| ZTE | Not quite follow the proposal here. The main bullet says to consider relative approach while the sub-bullet seems is to apply an absolute value for target performance.  Anyway, our preference is to consider an reasonable absolute value for target performance for respective scenarios/service. The value could be from operators demand, e.g. specific ISD value or MCL with 147 dB for voice.  We don’t agree to only consider relative MPL/MCL/MIL. We are not sure how to choose the channels to be enhanced based on relative approach. |
| Panasonic | We support the moderator’s proposal. Although the proposal is to adopt relative MPL/MLC/MIL target performance metric, it also includes “ISD value of X m for scenario Y and fixed MCL value of Z dB for VoIP shall be satisfied when identifying bottleneck channel(s) requiring coverage enhancement.” It also seems to consider absolute value. At least the relative MPL/MCL/MIL target performance satisfying the absolute value, we are OK to use relative target to identify the how much coverage improvement for each channel is necessary. |
| Nokia/NSB | From our perspective, this issue cannot be decoupled from what will be decided on the antenna array gain. More precisely:   1. If theoretical antenna array gain is considered, then MPL, MIL and MCL have the same descriptive power, i.e., they lead to the same conclusions. If this approach is chosen, then all metrics are equivalent. 2. If simulation-based antenna array gain is considered, then conclusions drawn for MCL, MIL and MPL may lead to different ones depending on broadcast/unicast setting, considered gNB implementation, CSI feedback accuracy, simulated ISD in SLS and so on. If this approach is chosen, then MPL should be preferred.   Switching the focus on how to determine the target performance of each channel, we observe the following. From our perspective, reference ISD targets could be considered as a reference to “put the bar somewhere reasonable” and give us some practically relevant support during the discussion. This could help us assessing realistically what we can expect from each channel. However, setting an ISD target and mapping it into corresponding MCL/MPL targets, without considering the actual achievable baseline MCL/MPL of each channel as a starting point, could be very close to an academic exercise if the ISD target itself is too optimistic. In fact, this would not give any guarantee that balanced coverage between UL and DL channels would be achieved, which is fundamental for a correct functioning of all NW operations. Conversely, focusing on minimizing/reducing the relative MCL/MPL difference between channels would help us assessing what needs to be improved to achieve such balanced coverage between DL and UL channels. Finally, we think that the priority should be given to enhancing the coverage of the identified bottleneck channel instead of defining a possibly unfeasible target performance. |
| Intel | We are generally fine with the proposal.  It seems to us “ISD value of X m for scenario Y and fixed MCL value of Z dB for VoIP shall be satisfied” is clearly the absolute MPL/MCL for performance metric. If this is the intention, we are fine with the proposal.  When determining the target performance for MPL/MCL, we need to take into account operator’s inputs on exact ISD for various deployment scenarios. |
| NTT DOCOMO | We support FL proposal. |
| SoftBank | From our side, the most important task of this SI/WI is to satisfy the market (operators’) requirement, which is basically given by absolute value. This should be considered as a top priority. If RAN1 wants to do more than that, absolute metric is not sufficient, and relative metric needs to be used.  In this sense, our view is similar to China Telecom, and we support their requirements on ISD values. |
| Ericsson | I’m not so clear on why this issue is something we have to resolve at this meeting. The link budget templates will provide measures of absolute as well as relative coverage, and so we can compare these to operator’s needs as well as take these into account when we decide on a work item in the plenary. I’m a bit concerned that we focus too much on setting precise targets:   * If we do not reach the targets, will the study item remain open? * Will we not also consider complexity, spec impact, power consumption, etc. as we normally do?   Is an alternative possible, where we first see what the performance is and then decide a way forward? |
| Qualcomm | We think we can revisit this after we have settled down on the link budget template and the definitions of the various terms are clear.  We also think there is no pressing need to agree to this in this meeting. We can all converge on a single template this meeting and finalize the performance metric in the next meeting. |
| InterDigital | We support to use relative MPL/MCL/MIL for target performance metric. |
| Vivo | MPL should be considered as a baseline. Other metrics, e.g. MCL, can be reported by companies.  For a target ISD and relative approach, we are fine with both proposals. For the former one, the target ISD should be determined carefully to make sure the coverage gap can be compensated by enhanced solutions. For the latter one, the bottleneck channel should not be limited to the worst one, other channels, e.g. the 2nd or 3rd worst channel, should not be simply excluded for coverage enhancements. |
| Samsung | In general, we are fine with moderator’s proposal (though our preference is Option 1 and Alt.1.) As commented above, a clarification would be needed for the 1st bullet and its sub-bullet (relative vs. absolute) |
| Sharp | We support FL proposal. |
| Apple | Not fully understand the proposal, if ISD value is decided then it seems not relative MPL, it’s pathloss based performance metric. For us, the Option 1 is preferred, the ISD can be based on operator’s input. For relative MPL/MCL/MIL, it’s not clear which channel should be used as the benchmark channel. |
| SONY | We are OK with the approach proposed by Ericsson / Qualcomm (see what the performance is and then determine a way forward).  If we need to have a target now, we would prefer to have a target MCL / MIL. The target MCL / MIL would be “at least as good as” UMTS and / or LTE (we understand that that was the original motivation of Softbank proposing 147dB MCL for VoIP). We would be OK if the target MCL / MIL were determined based on a consideration of ISD / MPL, but once that determination of target MCL / MIL had been made, we would like to focus on that target MCL / MIL. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | We support Ericsson and Qualcomm views. We can defer this to next meeting after the template is resolved. |
| CMCC | We are also a little confused on the 1st bullet of moderator’s proposal, which proposes the relative MxL in the main bullet and proposes an absolute value for voip in the sub bullet.  As proposed in our contribution, the MPL is preferred. And the ISD solution is slightly preferred. |
| Huawei, Hisilicon | We prefer the ISD based approach in Option 1 & Alt1, a coverage gap between available pathloss and target pathloss should be used to identify the coverage bottleneck channel.  For method of relative MPL/MCL/MIL for target performance, anyway, ISD need to be discussed, which is same as the ISD based approach in Option 1& Alt1. Furthermore, it’s quite hard to judge how many channels are coverage bottleneck channels without an absolute value of coverage gap. |

**Summary of the discussion:**

Companies’ views are quite diverse, which situation is somewhat similar to the previous meeting.

* Some companies are fine with moderator proposal
* Some companies have a concern on making a decision on target performance metric at this stage
* Some companies prefers to use absolute ISD based approach, which there is a company supporting absolute MCL/MIL based approach
* Some companies prefers to use relative based approach
* Companies still has different preference on MCL/MPL/MIL, while one company pointed out the difference of these three metrics depends on their definition (e.g. antenna array gain)
* Some companies mentioned that operators’ requirements should be fulfilled.

Given the situation above, it is not easy to decide a specific target metric at this meeting. Instead, the moderator would like to take a step-by-step approach and propose the following, which will be relatively less controversial.

**Moderator’s updated proposal:**

* RAN1 to strive for satisfying the operators requirements, which is given by absolute values:
  + For FR1 VoIP, MCL of 147dB and ISD of 500m for urban and 1732m for rural
    - Note: the MCL value may be adjusted depending on the definition of MCL
  + For FR1 eMBB, ISD of 500m for urban and 1732m for rural
  + (For FR2, companies input are encouraged)
* Continue discussion whether or not / how much coverage enhancements beyond the operators’ requirements will be performed.
  + Link budget template is used for this analysis
  + Complexity, spec impact, power consumption are taken into account
* The link budget template should include the all the potential performance metrics, i.e. MCL, MPL, MIL

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | It is difficult to set the absolute targets until we have results available and that are converged enough to allow meaningful comparisons to an absolute target. So we prefer further discussion on this proposal for now. |
| ZTE | We support the spirit of this proposal. But, as defined in the SI scope, we should also consider extreme long distance rural scenario, e.g. ISD=30km. Could you also add the target for this scenario?  As the target ISD for normal rural scenario, we are fine with ISD=1732 which is raised by one operator. But could you make it open also for only values since the values in ITU or TR 38.913 is 6000m or 5000m which should be also from real deployment. |
| China Telecom | We support the moderator’s proposal with some minor revisions.  **Updated proposal:**   * RAN1 to strive for satisfying the operators requirements, which is given by absolute values:   + For FR1 VoIP, MCL of 147dB and MCL/MPL/MIL derived from ISD of 500m for urban and 1732m for rural     - Note: the MCL value may be adjusted depending on the definition of MCL   + For FR1 eMBB, MCL/MPL/MIL derived from ISD of 500m for urban and 1732m for rural   + (For FR2, companies’ inputs are encouraged) * Continue discussion whether or not / how much coverage enhancements beyond the operators’ requirements will be performed.   + Link budget template is used for this analysis   + Complexity, spec impact, power consumption are taken into account * The link budget template should include the all the potential performance metrics, i.e. MCL, MPL, MIL |
| OPPO | We have a concern on the absolute values. Companies may obtain the different values by the different parameters in the link budget template. If Companies obtain the absolute value by a same link budget template, we support the updated proposal. |
| Samsung | For clarity, what is the definition of MCL (147dB for FR1 VoIP) in the updated proposal? In section 3.1, multiple definitions of MCL are discussed. |
| CMCC | The MPL should be considered as the performance metric |

**Summary of the GTW session**

It was pointed out the discussion on target performance metric is linked to the necessity of MPL as well as the choice of link budget template (IMT-2020 based or 36.824 based). As suggested by Chairman, the discussion under this section will be merged in open issue 3 in section 2.3, and hence this discussion is closed.

## Open but looks stable - [L] Open issue No.15 – target BLER for PDCCH (FR1 only)

We have an FFS for Target BLER for PDCCH, i.e. 10% BLER needs further discussion in this meeting.

|  |  |
| --- | --- |
| BLER for PDCCH | 1% BLER  FFS: 10% BLER |

One contribution discusses this issue, and proposes not to consider 10% BLER for PDCCH [5]. Companies are invited to input your views on this issue.

|  |  |
| --- | --- |
| Company | Comment |
| China Telecom | Remove 10% BLER. |
| OPPO | Support removing 10% BLER. |
| CATT | Don’t see the motivation of 10% BLER for PDCCH. Remove 10% BLER. |
| ZTE | No need to consider 10% BLER for PDCCH.  A low target BLER for PDCCH will have a great impact on system efficiency. Because once PDCCH is missed, a UE will be not aware of whether there is DL/UL transmission. Corresponding PDSCH/PUSCH re-transmission cannot be triggered in PHY layer. In addition, it will impact on PUCCH resource determination. This will decrease the HARQ-ACK BLER down to around 10%, meaning 1% target BLER for HARQ-ACK cannot be guaranteed. |
| Panasonic | We support removing 10% BLER. |
| Nokia/NSB | The motivation to consider 10% BLER is not clear and we agree with China Telecom and the proposal in [5]. |
| Intel | Remove 10% BLER |
| Ericsson | Reporting both 1% and 10% BLER allows us to understand a little better how sensitive the PDCCH is to a change in SINR, and so can be informative. Furthermore, there has been no discussion within this study of what an optimum PDCCH BLER is in a coverage limited scenario; why is 1% an ideal number? All that said, we do not insist that 10% is a mandatory value to simulate, and we do understand the wish to reduce the number of parameter settings to report upon. |
| Qualcomm | Let us stick to 1% BLER. It is well studied, and we know how the network behaves under this requirement. |
| Vivo | For PDCCH, 1% BLER is needed. |
| Samsung | Remove 10% BLER |
| Sharp | Support removing 10% BLER. |
| Apple | 1% BELR for PDCCH is enough. |

**Summary of the discussion:**

* 12 companies are OK to remove 10% BLER for PDCCH, or think 1% BLER is more important.
* 1 company think 1% BLER is not optimal for a coverage limited scenario, and 10% BLER will be useful.

Considering the less number of interest for 10% BLER for PDCCH, this should be treated as optional.

**Moderator’s updated proposal:**

* Update the BLER for PDCCH as follows:

|  |  |
| --- | --- |
| BLER for PDCCH | 1% BLER  ~~FFS:~~ (optional for 10% BLER) |

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Fine with moderator’s updated proposal |
| Nokia/NSB | Ok |
| Intel | We are fine with moderator’s updated proposal |
| vivo | We are fine with moderator’s updated porposal |
| OPPO | Fine with moderator’s updated proposal |
| Ericsson | Support operators proposal as a compromise. |

## Not started - [L] Placeholder – update of link budget template based on IMT-2020 self-evaluation

The discussion on link budget template will be started after we get the sufficient agreements, e.g. discussions in sections 2.3, 2.4, 3.1, 3.2, 3.3, 3.4 etc.

Moderator plans to perform the email discussion based on the rapporteur’s input in R1-2005733.

# Other issues related to evaluations

## Discussion needed - [H] Definition of MCL, MIL and MPL (FR1 & FR2 common)

As discussed in [12], it is proposed to clarify the definition of MCL. The main proposal by [12] is to include array gain to the conventional MCL definition to address the concern. Similarly thing is discussed by [14], which propose to add antenna and beamforming gain to the MCL based link budget table.

From these discussions, it seems that the exact definition of MCL is not aligned. In addition, we should make sure that the definition of MIL and MPL are aligned among companies.

* **For TDL Option 1 (see section No.9 in section 2.9 for the definition)**
  + Definition of MCL
    - Alt 1-1: Total transmit power – Receiver sensitivity + gNB antenna gain (component 2)
    - Alt 1-2: Total transmit power – Receiver sensitivity + gNB antenna gain (component 2 + 3) + UE antenna gain
    - Alt 1-3: Total transmit power – Receiver sensitivity + gNB antenna gain (component 2 + 3 + 4) + UE antenna gain
  + Definition of MIL
    - Total transmit power – Receiver sensitivity + gNB antenna gain (component 2 + 3 + 4) + UE antenna gain
  + Definition of MPL
    - Total transmit power – Receiver sensitivity + gNB antenna array gain (component 2+3+4 for TDL option 1) + UE antenna gain – (8) Cable, connector, combiner, body losses (Tx side) – (20) Receiver implementation margin + (21a/b) H-ARQ gain – (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain – (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)



* **For TDL Option 2 and CDL (see section No.10 in section 3.10 for the definition):** 
  + Definition of MCL
    - Alt 2-1: Total transmit power – Receiver sensitivity
    - Alt 2-2: Total transmit power – Receiver sensitivity + gNB antenna gain (component 2) + UE antenna gain
    - Alt 2-3: Total transmit power – Receiver sensitivity + gNB antenna gain (component 2 + 3) + UE antenna gain
  + Definition of MIL
    - Total transmit power – Receiver sensitivity + gNB antenna gain (component 2 + 3) + UE antenna gain
  + Definition of MPL
    - Total transmit power – Receiver sensitivity + gNB antenna array gain (component 2+3 for TDL option 2 and CDL) + UE antenna gain – (8) Cable, connector, combiner, body losses (Tx side) – (20) Receiver implementation margin + (21a/b) H-ARQ gain – (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain – (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)



|  |  |  |  |
| --- | --- | --- | --- |
| Company | Preference on MCL definition for TDL opt.1 | Preference on MCL definition for TDL opt.2 and CDL | Other comments |
| China Telecom | Alt 1-1 |  | We prefer TDL opt.1 with Alt 1-1. The definition of MCL should be clearly defined for NR. |
| OPPO | Alt 1-3 |  | We prefer TDL opt.1 with Alt 1-3. The definition of MCL should consider the antenna gain. |
| CATT | Alt 1-3 |  |  |
| ZTE | Alt 1-1 |  |  |
| Panasonic | Alt. 1-1 |  |  |
| Nokia/NSB | Alt. 1-x |  | We prefer TDL Option 1. On the other hand, we are not sure we understand the rationale of the proposed alternatives. We have the following observations:   * MCL as per IMT-2020 self-evaluation template does not include antenna array gains. This seems a reasonable approach because it allows to clearly differentiate among MCL, MIL and MPL. In particular, MCL depends exclusively on the channel configuration, i.e., on the considered features and configurations, whereas MIL and MPL also include factors related to architecture, gNB implementation, NW deployment and so on. In this context, we do not understand why all the Alt 1-x alternatives include a certain version of antenna array gain in the definition of MCL. * Connected to the previous point, if MCL as per any of the proposed alternatives is used, then it is not very clear why we need to discuss MIL. The two metrics would be extremely similar. Indeed, they would be identical in case of Alt 1-3, and have small difference (as compared to MCL vs. MPL) depending on how antenna array gain is modelled. * We do not understand why antenna gain component 4, which is a static value, should be considered a differentiating factor (it is between Alt 1-2 and Alt 1-3). This parameter should always be included in any of the “MCL versions”, if antenna array gain is included in MCL. * Definition of MPL is ok in our view.   In summary, we think that if MIL and MPL are defined as per above description, then MCL should be defined as per IMT-2020 self-evaluation template or dropped completely and use MIL instead. |
| Intel | Alt 1-3 |  | We are fine with Option 1. For Alt 1-1, we are not sure why UE antenna gain is not included. In our view, we should consider both gNB and UE antenna gain in order to have meaningful study for link budget analysis in practical deployment scenarios. |
| NTT DOCOMO | Alt. 1-3 |  | Generally, we are open for the MCL definition. It may be clear to us that MCL include both BS and UE antenna gains with beamforming gain. |
| SoftBank | Alt. 1-X |  | We see a strong necessity of a metric that does not include antenna gain. This is because legacy passive antenna will also be used in some scenario in the practical network. In addition, if antenna gain is included in MCL, it means that the definition of “conventional” MCL is changed from Rel-17. The definition of MCL should be kept as much as possible. In addition, the definition of MCL by IMT-2020 is to exclude antenna gain for both BS and UE. So, we would like to understand why option 1 family includes antenna gain component 2, and option 1-0 (Total transmit power – Receiver sensitivity) is not there. |
| Ericsson | MIL + MCL Alt 1, updated |  | Similar comments to Nokia. MIL (or ‘hardware link budget’ in the IMT-2020 template) includes both dynamic and static array and antenna gain, so it’s straightforward. However, it’s a bit of a philosophical question on whether to include receive array gain (‘component 2’) in MCL. If MCL does not include fixed array gain, then why should it include dynamic array gain? However, multiple receive chains can be seen as a way to improve sensitivity, and then dynamic array gain (and diversity gain) is included. For simplicity, our proposal is then  **MCL = MIL – antenna\_gain.**  As said earlier, MPL seems like extra effort, and it’s not clear to us why MCL and MIL are not sufficient for the study. |
| Qualcomm | Alt 1-1 |  | We are okay with definitions for MCL and MIL. For MPL, we prefer to comment (if necessary) after link budget template is finalized. |
| InterDigital | Alt 1-3 |  |  |
| vivo |  |  | We prefer MPL |
| Samsung |  |  | Prefer TDL Option 1. We share the view from Nokia as pointed in above observations |
| Sharp |  |  | We prefer not including antenna gains for MCL metric. |
| Apple | Alt 1-1 |  | According to our understanding, RAN4 gives the MCL definition. In 36.942, the MCL is defined as:  *MCL is the parameter describing the minimum loss in signal between BS and UE or UE and UE in the worst case and is defined as the minimum distance loss including antenna gains measured between antenna connectors.*  BS type 1-H defined in 38.104 is the gNB type we simulated, according to the gNB spec, the conducted test should be at the point after antenna gain component 2 in the figure. Then, the Alt 1-1 is aligned with the MCL definition. |
| SONY | Alt 1-X |  | Agree with comment from Softbank about inclusion of option 1-0 (Total transmit power – Receiver sensitivity). This seems to be the “classic” definition of MCL.  MIL definition for TDL option 1 is OK.  We think that MCL and MIL are sufficient and do not see the extra need for MPL. |
| CMCC |  |  | We are open to the MCL definition. And the definition of MCL is to facilitate the discussion and some company’s concerns. If the definition is clarified, it should be captured in the TR.  On the other side, from our understanding, the definition of MPL should follow the definition of IMT-2020 template. |
| Huawei, Hisilicon | Alt1-1 or Alt 1-2 |  | Either Alt1-1 or Alt1-2 is okay for the definition of MCL, except Alt1-3 which should avoid the same definition as MIL |

**Summary of the discussion:**

* For MCL definition on TDL opt.1:
  + 6 companies supports Alt 1-1
  + 5 companies supports Alt 1-3
    - it is also pointed out that MIL and MCL 1-3 are similar
  + There are a couple of comments that MCL should not include antenna gain
  + There are a couple of comments that IMT-2020 definition of MCL should be used
* For MIL and MLC on TDL opt.1:
  + No concerns on the definition
* For TDL opt.2 and CDL
  + No comment/preference was provided
  + Note: this discussion is common for FR1 and FR2. The definition may be needed if CDL is used for FR2.

Given the discussion above, Alt 1-3 may not be appropriate because MIL is sufficient. Therefore, Alt 1-1 or 1-0 (antenna gain is not included) should be further discussed in RAN. The moderator proposal is updated as follows

**Moderator’s updated proposal:**

* **For TDL Option 1**
  + Definition of MCL
    - Total transmit power – Receiver sensitivity + [gNB antenna gain (component 2)]
    - RAN1 to further discuss whether to keep “gNB antenna gain (component 2)” or not
  + Definition of MIL
    - Total transmit power – Receiver sensitivity + gNB antenna gain (component 2 + 3 + 4) + UE antenna gain
  + Definition of MPL
    - Total transmit power – Receiver sensitivity + gNB antenna array gain (component 2+3+4 for TDL option 1) + UE antenna gain – (8) Cable, connector, combiner, body losses (Tx side) – (20) Receiver implementation margin + (21a/b) H-ARQ gain – (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain – (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)
* **For TDL Option 2 and CDL**
  + Keep the discussion open for FR2
  + The decision will be made taking into account the definition for FR1

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Not quite support: We don’t see why MPL is needed; MCL and MIL are sufficient to determine coverage and bottlenecks. |
| China Telecom | In our understanding, TDL opt.1 can reduce the simulation burden in LLS, while the number of TxRUs in practical gNB antenna architecture is larger than 2 or 4. Note that the definition of MCL in 36.824 does not have such issue. In addition, to keep alignment between TDL opt.1 and TDL opt.2/CDL, antenna gain component 2 should be added, otherwise the value of MCL would be much smaller than TDL opt.2/CDL.  We prefer to delete the brackets for MCL definition in the moderator’s proposal, i.e.  Definition of MCL: Total transmit power – Receiver sensitivity + gNB antenna gain (component 2)  In addition, we think MPL should be kept. |
| OPPO | The antenna gain component 2 should be added for MCL. |
| Samsung | Fine with moderator’s updated proposal |
| CMCC | Fine with moderator’s updated proposal.  MPL should be kept and aligned with IMT-2020 template |

**Summary of the discussion at the GTW on 8/20**

Agreements:

* For TDL Option 1
  + Definition of MCL
    - Total transmit power – Receiver sensitivity + gNB antenna gain (component 2)
  + Definition of MIL
    - Total transmit power – Receiver sensitivity + gNB antenna gain (component 2 + 3 + 4) + UE antenna gain
  + Definition of MPL
    - Further discussion offline the definition using below as a starting point:
      * Total transmit power – Receiver sensitivity + gNB antenna array gain (component 2+3+4 for TDL option 1) + UE antenna gain – (8) Cable, connector, combiner, body losses (Tx side) – (20) Receiver implementation margin + (21a/b) H-ARQ gain – (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain – (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)
  + Note: whether/how to use the above definitions is to be discussed

The remaining issue given the agreement is the detailed definition of MPL, including whether or not MPL is necessary. This discussion is closely related to the decision in section 2.3 (link budget template & target performance metric).

**Moderator’s updated proposal**

* Definition of MPL
  + Total transmit power – Receiver sensitivity + gNB antenna array gain (component 2+3+4 for TDL option 1) + UE antenna gain – (8) Cable, connector, combiner, body losses (Tx side) – (20) Receiver implementation margin + (21a/b) H-ARQ gain – (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain – (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)
* Definition of MCL, MIL and MPL for TDL Option 2 and CDL
  + Definition of MCL
    - Total transmit power – Receiver sensitivity
  + Definition of MIL
    - Total transmit power – Receiver sensitivity + gNB antenna gain (component 2 + 3) + UE antenna gain
  + Definition of MPL
    - Total transmit power – Receiver sensitivity + gNB antenna array gain (component 2+3 for TDL option 2 and CDL) + UE antenna gain – (8) Cable, connector, combiner, body losses (Tx side) – (20) Receiver implementation margin + (21a/b) H-ARQ gain – (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain – (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)



|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Fine with moderator’s updated proposal |
| Nokia/NSB | Fine in general. We think we could drop “(28) Other gains” from the definition of MPL, for simplicity. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Should MIL and MPL for option-2 have been 3+4? |
| Intel | We are fine with moderator’s updated proposal |
| Ericsson | **Firstly, we agree with the comment that option-2 should have gNB antenna gain (component 3+4) rather than 2+3.**  **In general, we suggest to base MIL on IMT-2020 definitions and to derive MPL and MCL from MIL.** Our understanding is that parameter 23a/b (‘hardware link budget’) in the IMT-2020 spreadsheet is the same as maximum isotropic loss, and is compatible with the agreed definition of MIL from August 20. As was pointed out in the first GTW, interference margin is missing from the proposed MPL definition, so this should be corrected. Also, I think it should be OK to drop boosting gain for the purposes of evaluation in this study, but this is indeed a gNB implementation choice, and it is more transparent and clear to set the value to zero for now, and to remember this possibility if it appropriate to address later. Lastly, The IMT2020 template subtracts (12) ‘Cable, connector, etc. losses for UL’, but we don’t see why (12) is not within MIL (and MCL). So unless other companies can explain, we suggest it be omitted from MPL.  So, the simplest way forward seems to be to start with the IMT-2020 template definition for MIL and to derive MPL and MCL from MIL. The IMT-2020 template already does this for MPL. Given the agreed definition of MCL = Total transmit power – Receiver sensitivity + gNB antenna gain (component 2), this is equivalent to MIL – component(3+4), which then means that a single row can be added for MCL that is derived easily from MIL.  **Then we propose the following for both the TDL and CDL options:**   * MIL is derived according to the approach used in the IMT-2020 template, and MPL and MCL are derived from MIL: * Parameters may be set to zero and/or selected by companies * Further updates to parameters and values can still be discussed. * MIL = row 23a/b (Hardware link budget) of the IMT-2020 template   + For TDL, component 2 is provided in transmitter and/or receiver array gain parameters   + For CDL, component 2 is set to zero * MPL = (29a/b) Available path loss (dB) = MIL – Shadow fading (25a/b) + Macro Diversity gain (26) – Penetration Margin (27) + Other gains (28) * MCL = MIL – component(3+4) for Tx+Rx |
| NTT DOCOMO | We are fine with FL proposal. |
| Qualcomm | Regarding TDL Option 2 and CDL: I believe we are the only company running full-fledge sims with no simplifying assumptions on gNB TXRUs. To align with other companies, our intent is to declare AGC2 as 0 dB, and instead absorb AGC2 gains within the minimum required SNR identified via LLS. The figure that shows the four AGCs is general enough to permit this (we can set k=N).  With this interpretation, we can avoid a separate discussion for TDL Option 2 and CDL.  Regarding MPL:  Until the array gain/antenna gain components are resolved through other discussions, let us put them in square brackets.  We propose to drop (28) other gains and (26) BS selection/macro-diversity gain.  We propose to also drop (21a/b) HARQ gains, as pretty much all of us are running LLS with HARQ. We can add a note if necessary, to clarify that HARQ gains are absorbed as part of LLS.  We propose to merge shadow fading margin and penetration margin as a single parameter. From a technical standpoint, these are independent random variables and we should not be adding up standard deviations the way we do here. We don’t want to establish a bad precedent. If we represent this as a single parameter, then one can at the very least input a single parameter here based on SLS.  Also, the row numbers included will need to be removed/updated in the final version of this proposal as we will need a link budget template to go with this. |
| China Telecom | Regarding the illustration of antenna gain in the figures, there are four components for TDL opt1 and only three components for TDL opt2/CDL. To align the component’s index of antenna gain for TDL antenna architecture, we think the following updates on the figure may help:    In addition, we prefer keeping (28) Other gain in IMT-2020, which can handle some additional gains if exists. If there is no other gain, the value of (28) can be set as zero. |

**Summary of the discussion**

* 5 companies are OK with the (principle of) moderator proposal
* There are so may proposals to perform the optimization for the
  + 1 company to propose to derive MPL and MCL from MIL.
    - Note: this can be left to the discussion how to capture the agreements in the link budget table (section 2.16 of this document)
  + 2 companies proposed to remove (28 other gain) from the definition of MPL. On the other hand, 1 company wants to keep it.
  + 1 company proposed to remove (26 BS selection/macro-diversity)
  + 1 company proposed to remove (21a/b HARQ gain) – LLS may include this aspect. If not, it should be clarified.
  + 1 company propose to marge (25a/b Shadow fading ) and (27 Penetration Margin) – they are random parameter and shouldn’t be added up
* 2 company has a proposal to communalize the definition between Option 1 and option 2&CDL, i.e. adopt 0dB for antenna gain component 2
  + Note: the detail can be left to the discussion how to capture the agreements in the link budget table (section 2.16 of this document)
* 1 company propose to clarify that :
  + MIL = (23a/b Hardware link budget)
    - Note: This is moderator’s understanding and aligned with our agreement
  + MPL = (29a/b) Available path loss (dB) = MIL – Shadow fading (25a/b) + Macro Diversity gain (26) – Penetration Margin (27) + Other gains (28)
  + MCL = MIL – component(3+4) for Tx+Rx
    - Note: This is moderator’s understanding and aligned with our agreement

In order to handle the diverse view on this open issue, step by step approach would be ideally good to address all the concerns from the companies (Option 1). However, moderator thinks it is impossible have a discussion one by one considering the number of remaining issues and remaining time in at this meeting. Therefore, moderator would like to strongly suggest adopting option 2 below.

Option 1

**<1st step>: agree with square brackets**

* Definition of MPL for TDL option 1
  + Total transmit power – Receiver sensitivity + [gNB antenna array gain (component 2+3+4) ]+ UE antenna gain – [ (8) Cable, connector, combiner, body losses (Tx side) ] – [(20) Receiver implementation margin] + [(21a/b) H-ARQ gain] – [ (25a/b) Shadow fading margin – (27) Penetration margin ] + [(26) BS selection/macro-diversity gain ] + [(28) Other gains] – [(12) Cable, connector, combiner, body losses (Rx side) ]

**<2nd step>: discuss and agree how to treat the square brackets for MPL**

* [gNB antenna array gain (component 2+3+4)]
  + wait for the discussion in section 3.3
* [ (8) Cable, connector, combiner, body losses (Tx side) ]
  + clarification necessary if (8) is included in Total transmit power. If so, it can be removed.
* [(20) Receiver implementation margin]
  + clarification necessary if (8) is included in receiver sensitivity. If so, it can be removed.
* [(21a/b) H-ARQ gain]
  + Alt 1-1: remove this assuming that HARQ-gain is included in LLS result
  + Alt 1-2: keep it, and companies can report if HARQ-gain is included in LLS result
* [ (25a/b) Shadow fading margin – (27) Penetration margin ]
  + Alt 2-1: they are merged and one row is prepared
  + Alt 2-2: keep both of them
* [(26) BS selection/macro-diversity gain ]
  + Alt 3-1: remove this row
  + Alt 3-2 keep this row
* [(28) Other gains]
  + Alt 4-1: remove this row
  + Alt 4-2 keep this row
* [(12) Cable, connector, combiner, body losses (Rx side) ]

**<3rd step>**

* Definition of MCL, MIL and MPL for TDL Option 2 and CDL
  + The same definition as TDL option 1 applies, by setting the antenna array gain by antenna gain component 2 is set to 0.

Option 2

* Definition of MPL for TDL option 1
  + Total transmit power – Receiver sensitivity + gNB antenna array gain (component 2+3+4) + UE antenna gain – [ (8) Cable, connector, combiner, body losses (Tx side) ] – [(20) Receiver implementation margin] + (21a/b) H-ARQ gain – (25a/b) Shadow fading margin – (27) Penetration margin + (26) BS selection/macro-diversity gain + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)
  + for [ (8) Cable, connector, combiner, body losses (Tx side) ]
    - clarification necessary if (8) is included in Total transmit power. If so, it can be removed.
  + For [(20) Receiver implementation margin]
    - clarification necessary if (8) is included in receiver sensitivity. If so, it can be removed.
* Definition of MCL, MIL and MPL for TDL Option 2 and CDL
  + The same definition as TDL option 1 applies, by setting the antenna array gain by antenna gain component 2 is set to 0.

|  |  |
| --- | --- |
| Company | Comment |
|  | We do not support the definition of MPL as it omits factors including interference margin.  This definition of MPL is strange for us: the IMT-2020 template defines MPL in terms of MIL as below, and so the proposal seems unnecessarily more complex:  **MPL = (29a/b) Available path loss (dB) = MIL – Shadow fading (25a/b) + Macro Diversity gain (26) – Penetration Margin (27) + Other gains (28)**  The proposed definition also omits interference margin, which is included in the IMT-2020 template. The definition is also unclear with respect to what receiver sensitivity is, since there are now detailed parameter choices, unlike in the agreements for MIL and MCL. Since the moderator’s understanding is that MIL = (23a/b Hardware link budget), and since IMT-2020 defines MPL simply as MIL adjusted by 4 factors above, **we propose to use the IMT-2020 definition above, allowing companies to select appropriate values.**  **We’re fine to discuss (8) and (20).** |
| China Telecom | In fact, the calculation of MPL in IMT-2020 link budget template includes interference in the form of interference density as item (15a/b). Also, receiver sensitivity is defined in item (22a/b). Thus, we think the current MPL definition is OK.  Moreover, we prefer to maintain (8), (12), (20), (21). Based on agreements on MIL definition, we have the following updates on the definition of MPL.  **Definition of MPL = MIL - ~~[~~ (8) Cable, connector, combiner, body losses (Tx side) ~~]~~ – ~~[~~(20) Receiver implementation margin~~]~~ + (21a/b) H-ARQ gain – (25a/b) Shadow fading margin – (27) Penetration margin + (26) BS selection/macro-diversity gain + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)**  In our understanding, (8) is not included in total transmit power, and (20) is not included in receiver sensitivity. Thus, we suggest keeping (8) and (20). We share the same view on item (12) which was not mentioned in moderator’s proposal for Option 2. |
| Qualcomm | @Ericsson, MIL is not the same as HW link budget. Take a look at the spreadsheet I shared [here](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Inbox/drafts/8.4.1%20Baseline%20coverage%20performance/unifiedLinkBudgetForR17CovEnh.xlsx). Also, interference margin is included in receiver sensitivity. So it impacts MCL, MIL and MPL. This is the reason we wanted a common baseline with interference margin set to 0 dB for comparison.  We are okay to accept Option 1 with square brackets and debate the rest separately. We are also okay to use MIL as a starting point to define MPL. The steps as per IMT-2020 are outlined [here](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Inbox/drafts/8.4.1%20Baseline%20coverage%20performance/unifiedLinkBudgetForR17CovEnh.xlsx). |
|  |  |
|  |  |

**Summary of the discussion**

* 1 company expressed their concern on not having interference margin for MIL. 2 companies explained MIL has already included it in sensitivity
* No company explicitly support option 2
* During the email discussion, it was pointed out that companies have a different understanding on the definition of MIL
* Companies explained the reason why row(bla bla bla) is necessary/unnecessary.
* 1 company proposed allowing companies to select appropriate values.

Given the situation above, moderator sees the necessity of further clarification, what MCL, MIL exactly mean, before going to the discussion on MPL.

Moderator would like to share the updated proposal, which intends to confirm the understanding of companies.

**Moderator’s proposal: step 0**

* + Further clarify the Definition of MCL for downlink
    - Total transmit power – Receiver sensitivity + gNB antenna gain (component 2), where
      * Total transmit power corresponds to row No.(3)
      * Receiver sensitivity corresponds to row No.(22a/22b)
  + Further clarify the Definition of MIL for downlink
    - Total transmit power – Receiver sensitivity + gNB antenna gain (component 2 + 3 + 4) + UE antenna gain, where
      * Total transmit power + gNB antenna gain (component 2 + 3 + 4) corresponds to row No.(9a/9b)
        + (3) + (4) + (5) + (6) – (8) for control channel
        + (3) + (4) + (5) – (7) – (8) for data channel
        + Note: the derivation of (9a/9b) will be modified
      * Receiver sensitivity corresponds to row No.(22a/22b)
      * UE antenna gain corresponds to row No.(11)+No(11bis)
    - Note: As a result, MIL corresponds to hardware link budget

**Moderator’s proposal: step 1**

* Definition of MPL for TDL option 1
  + MPL = MIL – [ (8) Cable, connector, combiner, body losses (Tx side) ] – [(20) Receiver implementation margin] + [(21a/b) H-ARQ gain] – [ (25a/b) Shadow fading margin – (27) Penetration margin ] + [(26) BS selection/macro-diversity gain ] + [(28) Other gains] – [(12) Cable, connector, combiner, body losses (Rx side) ]

**Moderator’s proposal: step 2**

* Resolve the following square brackets, especially whether we keep it or not.
  + [ (8) Cable, connector, combiner, body losses (Tx side) ]
    - clarification necessary if (8) is included in MIL. If so, it can be removed.
  + [(20) Receiver implementation margin]
    - clarification necessary if (8) is included in MIL. If so, it can be removed.
  + [(21a/b) H-ARQ gain]
    - Alt 1-1: remove this assuming that HARQ-gain is included in LLS result
    - Alt 1-2: keep it, and companies can report if HARQ-gain is included in LLS result
  + [ (25a/b) Shadow fading margin – (27) Penetration margin ]
    - Alt 2-1: they are merged and one row is prepared
    - Alt 2-2: keep both of them
  + [(26) BS selection/macro-diversity gain ]
    - Alt 3-1: remove this row
    - Alt 3-2 keep this row
  + [(28) Other gains]
    - Alt 4-1: remove this row
    - Alt 4-2 keep this row
  + [(12) Cable, connector, combiner, body losses (Rx side) ]
    - discuss the necessity, which not used for MCL/MIL but MPL

**Moderator’s proposal: step 3**

* Confirm that definition of MCL, MIL and MPL for TDL Option 2 & CDL is the same as that for TDL option 1

**Moderator’s proposal: step 4**

* Discuss whether to allow companies to select appropriate value for each parameter

Since the discussion is too complicated to perform the document based discussion, moderator propose to trigger a separate email discussion to speed up our discussion.

## Discussion needed - [M] Downlink Tx power (FR1 only)

Three contributions pointed out the necessity of modifying the DL Tx power.

* 46.06 dBm [2]
* A power spectrum density of 33 dBm/MHz [5]
* the misalignment of the bandwidth in the template of IMT-2020 needs to be solved[12]

This is a new issue, and hence it would be appropriate to companies’ view on these proposals. Moderator’s proposal will be made based on the companies’ input.

|  |  |
| --- | --- |
| Company | Comment |
| CATT | We think the PSD for DL should be constant. The available power for DL transmission should be determined by the constant PSD and the occupied bandwidth. |
| ZTE | In current IMT-2020 template, the total transmit power for DL channels is based on the whole system BW, which is the maximum limit of gNB transmission power. But it seems not correct because the actual DL transmission power is based on the occupied BW and PSD.  There are two ways to go, one is correct the (3) Total transmit power in IMT-2020 template to be the PSD or we can change (17a)/(17b) Occupied channel bandwidth for DL data/control channel to be the system BW. |
| Nokia/NSB | We think a more intuitive way to model the Tx power used by gNB could be to set a constant EPRE value, e.g., 14-15 dBm, and obtain the total Tx power by scaling the EPRE by the occupied BW. |
| Intel | In the link budget analysis, constant PSD in DL should be assumed. It is more appropriate to assume that gNB transmits DL signals/channels within whole system bandwidth. |
| NTT DOCOMO | We support to use 44.07 dBm for the DL Tx power which is captured by the IMT-2020 template. |
| Ericsson | 33 dBm / MHz seems a common number within the industry to use and appropriate here for coverage studies. A constant EPRE can be a starting point for simulations. |
| Qualcomm | We prefer to go by the numbers suggested by the ITU M.2412 document ([link](https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-M.2412-2017-PDF-E.pdf)):  Rural deployment:  49 dBm for 20 MHz bandwidth  46 dBm for 10 MHz bandwidth  Urban deployment:  51 dBm for 100 MHz bandwidth |
| vivo | The transmission power/PSD used in R-REP-M.2412 can be considered as baseline. If parameters in real deployment can be provided by operators, we are fine to align with it. |
| Apple | For DL, the constant PSD is assumed, 33dBm/MHz is reasonable value. |

**Summary of the discussion:**

* 6 companies thinks constant PSD(or EPRE) is reasonable
* 3 companies propose to refer a value from outside of 3GPP (i.e. ITU document)

Considering the technical reasonability/fairness for evaluation, moderator would like to propose majority view for DL Tx power, i.e. use PSD for DL Tx power.

<update on 8/24>

If the definition of DL Tx power is changed to use PSD, there seems to be a need to change the definition of row(s) in the link budget table. In order to minimize the impact to link budget template, the following proposal can be made.

**Moderator’s updated proposal:**

* For DL Tx power,
  + A power spectrum density of 33 dBm/MHz is adopted
  + Modify the description of row(s) of link budget template:
    - Alt.1: Change the meaning of occupied channel bandwidth for control channel (17a) and data channel (17b)
      * for downlink, (17a) and (17b) mean system bandwidth
      * for uplink, (17a) and (17b) mean occupied bandwidth
    - Alt.2: Change the meaning of Total transmit power (row (3) ) :
      * (3) means the transmit power for occupied channel bandwidth for control channel (17a) or data channel (17b), and
  + Companies are requested to set appropriate values for parameters, which is used to determine total transmit power ( row (3) ), to satisfy the PSD of 33 dBm/MHz

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | Support  Either Alt 1 or Alt 2 is fine for us. But it’s better to choose one to make sure we use the same template if we are going to collect and calibrate the results from companies. |
| Samsung | Clarification questions:  1) With reference to the 3rd bullet, which parameter should be updated besides Alt.1 and Alt.2?  2) Applicable to FR2 as well? |
| Nokia/NSB | Preference for Alt.2. @Samsung: Current stable proposal for FR2 is based on a reference power over 100 MHz, i.e., 40 dBm which corresponds to 20 dBm/MHz. |
| Intel | We are fine with the updated proposal. One clarification: is this correct understanding that for DL, Alt. 2 means the potential PSD? If this is the case, we prefer Alt. 1. |
| NTT DOCOMO | We are fine to define PSD, on the other hand, 33dBm/MHz is too much for us. We prefer to use 24 - 26 dBm/MHz. |
| Qualcomm | Don’t agree. It doesn’t make technical sense. 33 dBm/MHz doesn’t seem to be backed up by any references as well.  Practical network deployments don’t scale total power based on PSD. We need to pay attention to the PAs and the bands under consideration.  Based on current LTE deployments, it is our understanding that most sub-GHz rural deployments operate with 46-49 dBm power. This appears to line up with the ITU guidelines as well. We have also checked with our on-field teams regarding these numbers. Operators are invited to provide more input if necessary.  For sub-GHz rural deployments we prefer to go with 46 dBm for 10 MHz or 49 dBm for 20 MHz. 40W macro base-stations is the most typical number.  For the MMIMO deployments in the 4 GHz band, we have been informed that 51 dBm over 100 MHz is the typical deployment. This too lines up with ITU guidelines provided in ITU M-2412 document. |
| vivo | Our preference is Atl1 |

**Summary of the discussion**

* 5 companies are OK to define PSD (alt 1 or 2 need further discussion/clarification)
  + 1 company propose to use 24 - 26 dBm/MHz instead of 33 dBm/MHz – 33dBm/MHz is too high
* 1 company sees the problem on the PSD of 33dBm/MHz – Tx power is not scaled based on PSD

Given the situation above, it is not easy to come up with a way forward because there is no “middle way” for this situation. On the other hand, recalling the discussion at RAN1#101-e, there are less number of companies who thinks DL channels are the bottleneck. If so, it is completely waste of time to spend much time on this issue.

Given the analysis above, moderator would like to ask companies which way to go.

* **Option 1:** The same assumption as IMT-2020 self-evaluation applies
  + If no consensus achieved, this option is adopted
* **Option 2:** Define PDS for DL Tx power, which is the majority view from the email discussion
  + **Option 2-1:** the PSD is 33dBm/MHz:
  + **Option 2-2:** the PSD is 24 - 26 dBm/MHz
  + Additional discussion how to capture this in the link budget table is necessary
* **Option 3:** use more practical value, e.g.
  + Rural deployment:
    - 49 dBm for 20 MHz bandwidth
    - 46 dBm for 10 MHz bandwidth
  + Urban deployment:
    - 51 dBm for 100 MHz bandwidth

Please input your view on the moderator proposal. Moderator’s preference is option 1.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Option 2-1. Since EPRE is constant without DL power control, the power for a DL channel is the power of its occupied bandwidth. For UL, EPRE scales down by the occupied bandwidth, and the total power is constant. |
| NTT DOCOMO | We support Option 2-2. If we will apply Option 1, we would like to clarify how to adopt the IMT-2020 values (e.g. (1) may be 64 ? and (3) is for 100 MHz ?) |
| Qualcomm | As a compromise, can we agree to separate PSD for rural deployments and urban deployments?  For rural, a PSD of 46 dBm/10MHz seems to nicely line up with a lot of LTE studies. Useful to have this as a reference.  For urban, we are okay to go with 33 dBm/MHz or lower if DCM prefers so.  As I explained on the reflector, the underlying technologies and deployment scenarios are quite different. |
| Nokia(Email) | The reason why we initially proposed to use constant EPRE assumption regardless of the bandwidth occupation (for DL), and thus agree on possible value(s) in this sense, is because this is the typical approach adopted at RAN4 to avoid issues with RF transient periods at the PA. Clearly many PA technologies exist, however we think that the goal here should be to perform studies which may have a general validity and, whenever possible, generally consistent with what RAN4 colleagues do (when it comes to RF-related considerations, at least).    Please also note that this would not prevent us from agreeing on an EPRE value which can be then mapped to total Tx power values aligned with specific set of values for different bandwidth occupations.    Having said this, we will not object the majority view, if such a view exists. Our concern was mostly related to the RF transient periods that happen due to sum power imbalances between symbols of different channels, as mentioned above. |

**Summary of the discussion**

* 1 company supports option 2-1
* 1 company supports option 2-2
* 1 company raised a concern on option1
* 1 company explained the reason why constant EPRE should be assumed.
* 1 company are OK to compromise with option 2 by applying scenario dependent PSD

Given the situation above, moderator would like to propose the following:

**Moderator’s updated proposal**

* Define PSD for DL Tx power, which is depend on deployment scenario
  + For 4GHz frequency,
    - For rural with long distance scenario, PSD is [24] dBm/MHz
    - For rural scenario, PSD is 24 dBm/MHz
    - For urban scenario, PSD is 24 dBm/MHz
  + For 700MHz, 2GHz and 2.6GHz frequency
    - For rural with long distance scenario, PSD is 36 dBm/MHz
    - For rural scenario, PSD is 36 dBm/MHz
    - For urban scenario, PSD is 33 dBm/MHz
* Modify the description of row(s) of link budget template:
  + Alt.1: Change the meaning of occupied channel bandwidth for control channel (17a) and data channel (17b)
    - for downlink, (17a) and (17b) mean system bandwidth
    - for uplink, (17a) and (17b) mean occupied bandwidth
  + Alt.2: Change the meaning of Total transmit power (row (3) ) :
    - (3) means the transmit power for occupied channel bandwidth for control channel (17a) or data channel (17b), and
* Companies are requested to set appropriate values for parameters, which is used to determine total transmit power ( row (3) ), to satisfy the PSD value above

Note 1: the value is decided in RAN1#102-e.

Note 2: From the 1st round discussion, there is not clear majority for alt 1 or 2. Moderator suggests to adopt the majority view in this round of discussion.

Note 3: The part in red is updated in v023.

Please input your view on the proposal above.

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | PSD values are acceptable. Please pick one compromise value for urban scenarios.  We prefer to have constant EPRE in DL, so for control channel, tx power is obtained by scaling PSD by the occupied bandwidth.  In uplink, tx power is held constant and spread over the allocated bandwidth. |
| CMCC | For the PSD for DL Tx power, **33dBm/MHz** is proposed for the Urban scenario, which is aligned with our commercial deployment.  And we also used the same type product for the rural scenario. Thus from our side, the PSD of **33dBm/MHz** is preferred for the Rural scenario.  For the modification of description of link budget, alternative 2 is preferred. Since it will be more straightforward to observe how much bandwidth are assumed in the link budget.  If allowed, slightly modifications (marked in red) of Alt 2 is proposed as below,   * + Alt.2: Keep ~~Change~~ the meaning of Total transmit power (row (3) ) and adding a new row (3 bis):   (3bis) means the transmit power for occupied channel bandwidth for control channel (17a) or data channel (17b), and |
| NTT DOCOMO | We support the values. For the link budget table, we support to use (3) for the system bandwidth (e.g. 100 Mhz for 4GHz), since occupied bandwidth is considered in the receiver side. |
| Ericsson | **Support Alt. 2**; in our understanding DL power control is not used, and so power is proportional to occupied bandwidth. **Might a compromise** be where Tx power is proportional to occupied bandwidth, but companies optionally use a non-zero power boosting gain (6) for data and/or control to boost the power? The boost would be zero by default and have a maximum allowable value that would boost the channel to be at the full rated power of the gNB. |

## Closed - [M] Antenna gain adjustment (FR1 and FR2 common)

Because behaviour of beamforming is different depending on the channels, the antenna gain and interference margin may need to be handled differently depending on the channels. This issue has been pointed out by some contributions. Note that this is related to open issue No.4 in section 2.4. The companies views in their contributions are captured below:

* The difference between broadcast and unicast beamforming gain should be considered in the evaluation. About 8dB broadcast beamforming gain loss is observed compared to unicast beamforming gain.[4]
* 10\*log(min(X, M/N)) - Δ, where X is the number of SSB beams [5]
* The losses of antenna array gain due to the UE location and the broader beam of common channels should be considered in the link budget. Introducing a beamforming gain loss could be considered. [12]
* Use antenna gain and interference margin values derived from system simulations in link budget analyses [19]
* Array gain = AGC1 +AGC2=10 \* 1og10 (number of antenna elements/number of TxRUs) + 10 \* 1og10 (number of TxRUs /number of RF chains) [28]

Companies are invited to provide their views on this aspect.

|  |  |
| --- | --- |
| Company | Comment |
| China Telecom | Whether the antenna gain is included in the link budget template or in LLS depends on the antenna structure. For TDL option 1, there are two alternatives of modelling of component 2 and 3.     * For TDL option 1, 2 or 4 gNB receive chains in LLS.   + Antenna component 1 is included in LLS and reflected in the required SNR.   + Antenna component 2/3/4 is are included in link budget template.   + Regarding the modelling of component 2 and 3, there can be two alternatives:     - Alt 1:       * Antenna gain component 2 = 10\*log(N/k).       * Antenna gain component 3 = 10\*log(M/N).     - Alt 2:       * Antenna gain component 2 = 10\*log(N/k) – Δ1       * Antenna gain component 3 = 10\*log(M/N) – Δ2       * Δ1, Δ2 can be reported by companies   The ranges of Δ1 and Δ2 vary from the value of M, N, k, and they also depend on gNB implementation. Hence, it seems difficult to align Δ1 and Δ2. Then, Alt 1 can be baseline, while Alt 2 can be optional with Δ1 and Δ2 reported by companies. |
| OPPO | Array gain = AGC1 +AGC2 -Δ=10 \* 1og10 (number of antenna elements/number of TxRUs) + 10 \* 1og10 (number of TxRUs /number of RF chains) -Δ  Δ is the losses of antenna array gain due to the UE location and the broader beam of common channels. |
| ZTE | Given a UE would be most possibly not in the bore sight of a beam, a more realistic modeling on the antenna array gain is preferred. That is, we prefer Alt 2 as provided by China Telecom.  For broadcast channels, the beamforming gain is not only limited by the number of elements per TxRU but also limited by SSB beam number (denoted as X). A model as 10\*log(min(X, M/N)) - Δ can be considered. |
| Nokia/NSB | We are fine with both using SLS or suitably corrected theoretical antenna array gain calculation. If the chosen approach is based on corrected theoretical antenna array gain calculation, then we are fine with Alt. 2 as proposed by China Telecom. |
| Intel | In our view, Alt. 1 mentioned by China Telecom is the maximum antenna gain that can be considered as an upper bound for link budget analysis. For realistic analysis, it is more appropriate to consider Alt. 2 with additional antenna gain loss so as to identify the performance bottleneck for different physical channels in various deployment scenario. Accordingly, corresponding performance gap may be derived, i.e., how many dB needs to be improved for the physical channels with performance bottleneck. Further, SLS needs to be conducted to evaluate the antenna gain loss and companies can report their own findings in link budget analysis. |
| NTT DOCOMO | We are fine to use a single value for the antenna gain with beamforming gain. |
| Ericsson | Support China Telecom’s Alt 2. More realistic values than simply 10log(N) are needed, and that the non-idealities are different for components 2 and 3. For example, channel estimation can drive receive array gain losses for component 2, and the UE may not be in the boresight of the fixed antenna pattern of component 3. The fixed antenna pattern can have significant losses since ‘cell edge’ UEs may not be in the main beam of the antenna. We discuss more in R1-2006611 (section 4) and R1-2006616. |
| Qualcomm | Please see our comment in Section 2.4. In addition to the four gain components identified in the figure in Section 3.1, we need at least 2 correction factors here. One correction term is for imperfect beamforming/combining due to channel estimation errors (ΔchEst). A second correction term (Δbcast) is needed to differentiate between broadcast and unicast channels, and could be tied the number of SSB beams especially in the FR2 context. |
| InterDigital | Our view is aligned with Alt. 2 from China Telecom. Deltas can be reported by companies. |
| vivo | The 5-th sub bullet can be considered as the baseline array gain, that is the unicast beamforming gain is 10 \* 1og10 (number of antenna elements/number of TxRUs) + 10 \* 1og10 (number of TxRUs /number of RF chains)  Beamforming gain loss due to other factors, e.g. tilt angle and difference between broadcast and unicast BF, can be reported by companies.  Based on our simulation, the difference between broadcast and unicast beamforming gain should be considered in the evaluation. About 8dB broadcast beamforming gain loss is observed compared to unicast beamforming gain. |
| Samsung | Fine with Alt.1 from China Telecom for the alignment among company’s results |
| Sharp | For broadcast channels, array gain should be 10\*log10(NSSB) where NSSB is the number of SS/PBCH blocks. The value ofΔ can be further discussed. |
| Apple | We are not clear how to differentiate the Δ1 and Δ2 from the system level simulation. Do we intend to calibrate the antenna array gain loss from SLS? If not, I believe the results will be quite diverse. As the results only impact on the link budget, I agree with CTC, the Alt1 can be the baseline. |
| Huawei, Hisilicon | For bullet 1, we agree that difference between broadcast and unicast beamforming gain should be considered while the gap can be further discussed.  For bullet 2, it’s a model of broadcast beamforming, whether is accurate or make sense, further discussion is needed.  For bullet 3, we agree that a beamforming gain loss can be introduced in the link budget, either in terms of adding a new parameter or simply report the practical beamforming gain values by different companies.  For bullet 4, it’s quite hard to coverage the values based on SLS from different companies and operators.  For bullet 5, AGC2 is introduced in the array gain based on the equation in IMT-2020. More accurate but the template will be more complicated, this can be further discussed. |

**Summary of the discussion:**

* China Telecom gave a good summary for the potential definition for antenna gain:
  + 4 companies support Alt 1 (including baseline)
  + 10 companies support Alt 2 (or their idea is compatible with Alt 2)
    - there is a concern that the simulation result for delta may be so diverse that the comparison will be difficult.

From moderator’s understanding, Alt 2 has the following benefits:

* It can represent the difference of beamforming behavior among channels, which companies think important
* Alt 2 is very flexible: obviously it is a superset of Alt 1.

Therefore, moderator would like to propose the following:

**Moderator’s updated proposal:**

* For the antenna gain definition for TDL option 1:
  + Antenna component 2/3/4 is included in link budget template.
  + Antenna gain component 2 = 10\*log(N/k) – Δ1
  + Antenna gain component 3 = 10\*log(M/N) – Δ2
  + Δ1, Δ2 can be reported by companies
* Note: antenna gain component 2,3,4 and k, N, M are defined in the figure below:



Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| InterDigital | We support the updated proposal from the moderator. |
| Samsung | Can live with the updated proposal. Though still have a concern on the difficulty of comparison |
| ZTE | For antenna gain component 3, about proposal only applies to unicast beamforming gain. For broadcast channels, the beamforming gain is not only limited by the number of elements per TxRU but also limited by SSB beam number (denoted as X). A model as 10\*log(min(X, M/N)) - Δ can be considered. |
| Nokia/NSB | Aligned with Samsung. The considered model is quite clear, in principle; however, we wonder if we really need to be so specific with the differentiation of the different deltas for different antenna gain components. This may significantly complicate comparison of results across companies. Couldn’t we simply have one overall delta to simplify the comparison between results? |
| Intel | Share similar view as Nokia. It would be also good to differentiate the antenna gain for broadcast and unicast channel. |
| Qualcomm | We think we need one correction factor to account for broadcast vs unicast differences and one to account for imperfect beamforming/combining.  Thus we separately identify two correction terms for very specific reasons.  There is no need to associate these factors with any one gain component.  If we are allowed the interpretation offered in Section 3.1, we don’t think a separate discussion is needed for TDL Option 2 + CDL. |
| vivo | We are fine with moderator’s updated proposal |

Additional note from moderator (added on 8/24)

Discussion on the antenna gain definition for TDL option 2 and CDL will be performed after that for TDL option 1 is concluded.

**Summary of the discussion**

* 2 company is OK for the moderator proposal
* 3 companies have a concern on the complexity, and they see the necessity of simplification
  + at least one delta would be sufficient
* 1 company sees the necessity for two correction factors, but they are not related to components
* 1 company don’t want to have a separate discussion for TDL option 2 & CDL
* 1 company want to adopt 10\*log(min(X, M/N)) – Δto address the difference between unicast & broadcast

To address the concern above, moderator would like to update the proposal as follows:

**Moderator’s updated proposal:**

* Introduce one row in the ling budget template, which is used for antenna array gain correction
* Companies can report the how the delta is calculated (i.e. gain difference between broadcast & unicast and so on)
* Note: the discussion on antenna gain is performed under section 2.4.

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | In our view, this should be a high priority item, since 1+2 can be large and given its relation to the high priority item in 2.4.  We think it is important to differentiate between the impairments to dynamic beamforming (channel estimation, imperfect CSI, etc.) and those due to a fixed antenna pattern (where the UE is not in the boresight and/or angle spread, etc.) The fixed pattern effects can be quite substantial; at 4 GHz we observe roughly 6-7 dB loss from this on the uplink. However, the dynamic part, while important is less: on the order of a few dB at 4 GHz on the uplink. Since the fixed part is hard to improve with better transmission schemes, this is one motivation for using both 1 and 2. It is also more clear if companies choose to set a  value to zero to show what their assumption is. Putting 1 and 2 on separate rows from the ideal gains they offset is OK, but we are also OK to have rows for the fixed and dynamic gains that are of the form 10\*log( ) – Δ.  **So our proposal is: Account for 1 and 2 in the link budget template as separate rows or by combining them with the corresponding antenna & antenna array gain values.** |
| Qualcomm | Mostly in alignment with Ericsson (above) and Nokia(in email). We need one factor to account for broadcast/unicast and non-ideal beamforming. This factor should be reflected in MCL. It should be treated as a correction factor on top of AGC2.  The second correction is to be treated as a correction factor for AGC3 + AGC4. Input from SLS could inform the choice of the exact value used. |
| Nokia (Email) | At high-level, we share Qualcomm’s view on this, meaning that from our perspective:     * Differentiation between broadcast and unicast channels should be captured in AGC2. This may or may not be captured by LLS depending on how simulations are performed, how many TxRUs are simulated and so on; * AGC3 and ACG4 are static parameters which are affected by the physics of the propagation (including wideband analogue beam number and “form” for AGC3). Differentiation between broadcast and unicast is not expected to happen at this level, and their contribution is not captured by LLS.     In this context, we would expect to have two types of correction to be applied to the maximum theoretical antenna array gain calculated using the “log formula(s)”:     1. A correction on AGC2 which depends on broadcast/unicast differentiation and also accounts for non-ideal beamforming/combining due to imperfect channel estimation; this implies that such a correction factor impacts both MCL, MIL and MPL (according to the definitions we agreed on). 2. A correction on AGC3 which depends on the UE’s angular location in reference to the gNB antenna panel, e.g., aligned with analogue beam bore-sight or not; this implies that such a correction factor impacts only MIL and MPL (according to the definitions we agreed on).     We are not sure an actual correction on AGC4 is necessary, being the latter a parameter which depends on how AEs are actually designed, e.g., how many radiating elements per AE we have and so on. On the other hand, if companies believe a correction should applied here as well, then this would contribute to the second correction above.    Now, assuming we understood your intention when writing them, we are not sure either of the two alternatives you propose below may capture what is described above.    Finally, we would like to note that according to the discussion we had last week, what will be shared and discussed in future contributions is very likely only the MCL/MIL/MPL values related to each considered channel/procedure, and not the full LB templates. Hence, and provided we stabilize the understanding of antenna array gain modeling and its general principles, we are not sure it is so relevant to agree on:     * how many deltas we have in the antenna array gain modeling; * how many rows we use to capture the contribution of all the AGCs. |

Summary of discussion

* 2 companies clarified the use case of gain correction factor
  + AGC2:
    - broadcast/unicast differentiation and also accounts for non-ideal beamforming/combining due to imperfect channel estimation
    - This has an impact on MCL, MIL and MPL
  + AGC3 (+AGC4):
    - UE’s angular location in reference to the gNB antenna panel, e.g., aligned with analogue beam bore-sight or not;
    - This has an impact on MIL and MPL
  + No company identify the necessity for separate antenna gain correction factor for AGC4
* 2 companies recommend having 2 antenna gain correction factors for AGC2 and AGC3, respectively.
* 2 companies think antenna gain correction factors for AGC2 and AGC3 can (should) be combined for simplification.

Given the analysis above, it would be appropriate to introduce two gain correction factors for AGC2 and AGC3, respectively even though this will increase the complexity of our analysis. Note that this discussion is closely related to antenna gain discussion in section 2.4. Therefore, moderator will prepare a joint proposal in 2.4. The discussion in this section is closed.

## Discussion needed - [M] Interference handling (FR1 and FR2 common)

Two contributions discuss about the necessity to consider the interference margin for link budget, which may be derived from SLS.

* Use antenna gain and interference margin values derived from system simulations in link budget analyses [19]
* Receiver interference density for FR1 can reuse the values from ITU self-evaluation if available, or via SLS [5]

Companies are invited to provide their views on this aspect.

|  |  |
| --- | --- |
| Company | Comment |
| China Telecom | We prefer to reuse the values of receiver interference density for FR1 as much as possible from ITU self-evaluation. |
| OPPO | We prefer to reuse the values of receiver interference density which can be find in the ITU self-evaluation, and obtain receiver interference density via SLS if the values are not included in the ITU self-evaluation. |
| CATT | Share the same views as CTC. |
| ZTE | Interference density is highly dependent on the deployment scenarios and carrier frequency. We can only anticipate to get this value by SLS if there is no value can be referred in existing IMT 2020 template. |
| Panasonic | To reuse the values from ITU self-evaluation if available, could reduce evaluation effort, but we are open to use SLS. |
| Nokia/NSB | Agree with China Telecom. We prefer this number to be spelled out in an agreement, if possible, to avoid ambiguities. |
| Intel | We share similar view as China Telecom. |
| Ericsson | Similar comment to ZTE: realistic interference margins derived from SLS should be used and these should be according to a clearly defined scenario. That said, our observations are that antenna gains will dominate interference margins. |
| Qualcomm | This proposal is dependent on the link budget template we choose to use. We will provide additional input after we agree on link budget template. |
| vivo | Option 2 is preferred. If via SLS, specific value of interference density may need to be discussed. As guided by the SID, the evaluation should be based on LLS, and spending too much time on discussing the SLS simulation assumptions should be avoided. Companies can report their parameters which are different from the assumptions in ITU self-evaluation. |
| Samsung | Agree with reusing the values from ITU self-evaluation |
| Apple | We share the same view as China Telecom. If we don’t have agreed SLS assumption, how to calibrate the results from different companies? |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | For the case of extreme coverage scenarios, the system tends to be noise-limited as opposed to interference-limited. The ITU link budget templates do not account for such extreme cases. Therefore, the interference power density must be accounted for extreme coverage deployments. |
| Huawei, Hisilicon | Values of antenna gain and interference margin from SLS is closely related to SLS parameter settings, such as ISD, UE distributions, etc. If adopt values from SLS, an agreement for SLS parameter settings should be achieved. Alternatively, we could reuse the values from IMT-2020 self-evaluation templated if available. |

**Summary of the discussion:**

* 11 companies want to reuse the values ITU self-evaluation.
* 2 companies think SLS is necessary to obtain realistic interference value.
* 1 company proposes to consider extreme coverage deployments, since it tends to noise limited scenario.

Moderator thinks, considering the majority view, it would be good to reuse the value for ITU-self evaluation to avoid diverse evaluation results as much as possible. Optionally, companies can report their parameters, which are different from the assumptions in ITU self-evaluation

**Moderator’s updated proposal:**

* For receiver interference density
  + The values used for ITU self-evaluation is reused.
  + The other values, e.g. obtained by SLS, can be optionally used.

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Support |
| Nokia/NSB | Fine but we would like to have the numbers spelled out in an agreement (for calculations not based on SLS). This would ensure that everyone uses the same reference numbers. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | For extreme long coverage, the values from IMT 2020 are not applicable. Request clarifications. Also agree with Nokia |
| Qualcomm | Since the ITU number have no clear basis, we prefer to not consider interference. This is in accordance with 36.824 and 38.913 where for link-level evaluations, it is clearly stated that 0 dB margin for interferene is mandatory, while other number can also be suggested as per company preference.  Lets aim to compare results with 0 dB margin. We can have a separate table with other assumptions if necessary. |
| vivo | It has been agreed that “RAN1 will not further discuss on specific values for the parameters related to MPL”, it seems no further agreement is needed. |

**Summary of the discussion:**

* 3 companies support the moderator proposal
* 2 companies see the need to spell out the numbers
* 2 companies think SLS is necessary to obtain realistic interference value.
* 1 company proposes not to consider interference (i.e. 0dB) as baseline
* 1 company sees the necessity on the value for extreme long coverage
  + (Note: moderator’s understanding is that we have to use the value reported by companies, if it is not defined for IMT-2020 self evaluation)
* 1 company mention no more discussion is necessary on this aspect given the agreement that “RAN1 will not further discuss on specific values for the parameters related to MPL”
  + (Note: moderator’s understanding is that this is not the case because interference density has a impact on MIL as well as MPL)

Moderator views that capturing (IMT-2020) values for interference density is a good approach to ensure that everyone can use the same value. As for the proposal to use 0dB interference, moderator sees some problem to adopt 0dB as a baseline because interference is a dominant facture in IMT-2020 self-evaluation. In addition, if companies want to simulate the difference of interference among channels, this approach doesn’t work well.

Moderator would like to further correct the view from companies, which alternative is the better way to go.

**Moderator’s updated proposal:**

* For receiver interference density
  + Alt .1 The values used for ITU self-evaluation is reused, which are defined in Appendix C.2 of TR 37.910 "Study on self evaluation towards IMT-2020 submission"
    - PDSCH/PDCCH: -169.3 dBm/Hz
    - PUCCH: -161.7 dBm/Hz
    - PUSCH: -165.7 dBm/Hz
  + Alt 2. [0]dB for all scenarios as baseline
    - The other values, e.g. obtained by SLS, can be optionally used.

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | **Prefer an Alt 2’, where companies can report values used.** 0 dB interference rise is clearly the ideal case, and should not be prioritized. Companies should be encouraged to provide more accurate results based on their system simulations. Also, the values we are observing are lower than the ITU self evaluation values reported above. |
| Qualcomm | Prefer Alt 2. We see no other means to align across all companies. Interference margins even among companies with SLS does not seem to align. Foresee lots of issues here if we don’t use 0 dB margin as a baseline for comparison. |

**Summary of the discussion:**

* No companies support alt 1 (note: there are a couple companies supporting this in the previous round of discussion)
  + 1 company mentioned the they observe the actual interference value is lower than that of IMT-2020 self evaluation
* 1 company supports alt 2
  + this is the only way to align across companies, and classically used in 3GPP
  + one company raised a concern because it is ideal case
* 1 company supports alt 2’, i.e. companies can report the value used

At this moment, moderator doesn’t see the point of compromise. Moderato wonders whether Alt 1’ can be the possible way forward for the sake of progress.

**Moderator’s updated proposal:**

* For receiver interference density
  + Alt .1 The values used for ITU self-evaluation is reused, which are defined in Appendix C.2 of TR 37.910 "Study on self evaluation towards IMT-2020 submission"
    - PDSCH/PDCCH: -169.3 dBm/Hz
    - PUCCH: -161.7 dBm/Hz
    - PUSCH: -165.7 dBm/Hz
    - The other values, e.g. obtained by SLS, can be optionally used.
  + Alt .1’ The values used for ITU self-evaluation is reused, which are defined in Appendix C.2 of TR 37.910 "Study on self evaluation towards IMT-2020 submission"
    - PDSCH/PDCCH: -169.3-X dBm/Hz
    - PUCCH: -161.7-X dBm/Hz
    - PUSCH: -165.7-X dBm/Hz
    - The other values, e.g. obtained by SLS, can be optionally used.
    - Note: X is determined at RAN1#102-e
  + Alt 2. Interference is not considered for all scenarios as baseline
    - The other values, e.g. obtained by SLS, can be optionally used.
  + Alt 2’. Companies can report values used

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | Alt 2.  Interference margins are deployment dependent, i.e., ISD, number of antennas matters, propagation characteristics, etc, need to be taken into account. ITU guidance is wrong here and not applicable to all bands and deployments.  Ideally we should get these numbers from SLS. In the absence of SLS, due to the divergence across companies, it is best to leave this out for baseline comparison. In addition to baseline, companies can report their preferred interference margins. |
| CMCC | Alt 1 is preferred.  The values from ITU self-evaluation could be reused. And the values could be proposed from companies who have the SLS. Consideration without interference is not appropriate.  For the Alt 1’, we are not sure if we have enough rational sources for the value X in RAN1#102-e. Companies are encouraged to provide their values and views ASAP.  In the next meeting, companies will update their link budgets, and the updated results would be captured in the TR. So reuse currently what we have could be a way forward, though it may not be theoretically perfect. |
| Ericsson | **While we think interference is important, we refer an Alt 2 over Alt.1, based on current understanding that IMT values are large.** While 0 dB interference rise is clearly the ideal case, the values we see from IMT look large, and it may be better to have 0 dB than these values. Moreover, companies should be encouraged to provide more accurate results based on their system simulations. |

## Closed - [M] Shadow Fading (FR1 only)

Contribution [2] proposes to modify shadow fading margin because IMT-2020 doesn’t cover the particular scenario.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameters | Urban  TDD | Rural NLoS  TDD | Rural NLoS  FDD | Rural with long distance FDD |
| (24) Lognormal shadow fading std deviation (dB) | 7 (NLoS) | 8 (NLoS) | 8 (NLoS) | 6 (LoS) |
| (25a) Shadow fading margin for control channel (function of the cell area reliability and (24)) (dB) | 7.56 | 10.45(O2O)  8.45(O2I) | 10.45(O2O)  8.45(O2I) | 6 |
| (25b) Shadow fading margin for data channel (function of the cell area reliability and (24)) (dB) | 4.48 | 6.61(O2O)  5.13 (O2I) | 6.61(O2O)  5.13 (O2I) | 4.79 |
| (27) Penetration margin (dB) | 26.25 | 9(O2O)  14.53 (O2I) | 9(O2O)  12.5 (O2I) | 9 |

Companies are invited to provide their initial view on this proposal.

|  |  |
| --- | --- |
| Company | Comment |
| China Telecom | We prefer to reuse the values of shadowing fading for FR1 as much as possible from ITU self-evaluation. |
| OPPO | If the scenario is not in the IMT-2020, the parameters for the scenario need to determine. |
| CATT | Share the same views as CTC. |
| ZTE | We are fine with the proposed values in above table which makes sense to us to align the values for different channels. |
| Nokia/NSB | For SF margin, the value for Rural NLoS O2I seems incorrect. For example, for data channel with STDSF = 8 dB, STDPenetrationLoss = 4.4 dB (for O2I, low-loss) and slope = 38.63 (BS high = 35m), considering the Effective STD = sqrt(STDSF2 + STDPenetrationLoss2), the correct value for Rual NLoS O2I should be 6.34 dB.  We are fine with other SF values. |
| Intel | We share similar view as China Telecom. |
| Ericsson | If it is necessary to define a shadow fading margin, it should be according to a clearly defined scenario / use case. |
| Qualcomm | This proposal is dependent on the link budget template we choose to use. We will provide additional input after we agree on link budget template. |
| vivo | Share the same views as CTC.  The value of shadow fading margin is based on effective shadow fading standard deviation and area coverage probability requirement, and effective shadow fading standard deviation will be same when carrier frequency is under 6GHz. Therefore, once the scenario and pathloss model are confirmed, shadow fading margin should be same in all carrier frequency when under 6GHz. |
| Apple | We share the same view as China Telecom. |
| Huawei, Hisilicon | Shadow fading margins under different scenario varies with some key parameters, such as BS height, horizontal indoor propagation distance, cell radius, etc. In reusing the IMT-2020 template, shadow fading margins should be revised once above mentioned parameters are changed. |

**Summary of the discussion:**

* 5 companies want to reuse the values ITU self-evaluation.
* 3 companies are OK to modify the values.

It seems that companies are not convinced why the modified values are necessary for urban TDD case given the values used for ITU self-evaluation.

**Moderator’s updated proposal:**

* Proponents are encouraged to elaborate more why the new values are necessary.
* If the situation is not changed, the values used for ITU self-evaluation is applied for urban TDD.

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Fine with the updated proposal |
|  |  |

**Update on 8/24**

Given the agreement captured in 2.3, RAN1 will not further discuss on specific values for the parameters related to MPL. Therefore, this discussion is closed without any conclusion.

## Closed - [M] Penetration margin (FR1 only)

There are two proposals for penetration margin:

* For penetration margin determination for O2I case, a more accurate model as in Table 7.4.3-1 and Table 7.4.3-2 of TR 38.901 should be used [5]
* Penetration margin for urban TDD is proposed as follows [2]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameters | Urban  TDD | Rural NLoS  TDD | Rural NLoS  FDD | Rural with long distance FDD |
| (27) Penetration margin (dB) | 26.25 | 9(O2O)  14.53 (O2I) | 9(O2O)  12.5 (O2I) | 9 |

Companies are invited to provide their initial view on this proposal.

|  |  |
| --- | --- |
| Company | Comment |
| China Telecom | We prefer to reuse the values of penetration margin for FR1 as much as possible from ITU self-evaluation. |
| OPPO | We prefer to use a more accurate model as in Table 7.4.3-1 and Table 7.4.3-2 of TR 38.901. |
| CATT | Share the same views as CTC. |
| ZTE | More accurate model in Table 7.4.3-1 and Table 7.4.3-2 of TR 38.901, which is frequency and penetration material dependent, should be used. For urban scenario, 50% low-loss and 50% high-loss models can be considered. Only the low-loss model is applicable to rural scenario. More specifically, the penetration margins for different O2I cases are given in the following table (IMT-2020 value is also given as a reference).   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | |  | 4G (Urban) | 2.6G (Urban) | 4G  (Rural) | 2.6G (Rural) | 2G (Rural) | 700MHz  (Rural) | | IMT-2020 Template | 26.25 | - | ~~-~~ | - | - | 12.5 | | TR 38.901 | 26.68 | 24.56 | 15.38 | 14.76 | 14.33 | 12.74 |   For O2O case, 9 dB penetration margin is suggested. |
| Nokia/NSB | For penetration margin, we would like to understand why the penetration margin for Rural NLoS O2I are different for FDD and TDD, given that both scenarios are sub-6GHz. |
| Ericsson | If it is necessary to define a penetration margin, it should be according to a clearly defined scenario / use case. |
| Qualcomm | This proposal is dependent on the link budget template we choose to use. We will provide additional input after we agree on link budget template. |
| vivo | We agree with this proposal. |
| Apple | We share the same view as China Telecom. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | Rural with long distance should also include TDD. |
| Huawei, Hisilicon | The values presented in the above table follows the calculation method TR 38.901, which is consistent with bullet 1. For penetration from outdoor to indoor, the loss varies with frequency carriers and should be revised. |

**Summary of the discussion:**

* 3 companies want to reuse the values ITU self-evaluation.
* 3 companies are OK to modify the values.
* 2 companies seem to require more discussion.
* 1 company proposes to consider rural long distance scenario, but it is not clear what need to be considered.

It seems that companies are not convinced why the modified values are necessary for urban TDD case given the values used for ITU self-evaluation.

**Moderator’s updated proposal:**

* Proponents are encouraged to elaborate more why the new values are necessary.
* If the situation is not changed, the values used for ITU self-evaluation is applied for urban TDD.

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Fine with the updated proposal |
|  |  |

**Update on 8/24**

Given the agreement captured in 2.3, RAN1 will not further discuss on specific values for the parameters related to MPL. Therefore, this discussion is closed without any conclusion.

## Stable - [M] Simulation assumptions for SLS based evaluation (FR1 only)

SLS based evaluation has been agreed as an optional method for coverage analysis. The detailed simulation assumptions are provided by [27]

Table 2 SLS specific parameters

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Urban/Rural scenario for FR1** | **Urban/Indoor scenario for FR2** |
| Layout | Single layer - Macro layer: Hex. Grid | Urban: Single layer - Macro layer: Hex. Grid  Indoor: 12BSs per 120m x 50m |
| Channel model | UMa in TR 38.901  RMa in TR 38.901 | UMa in TR 38.901  Indoor-office in TR 38.901 |
| Min distance of UE2gNB | 35m for urban  35m for rural | 35m for urban  0m for indoor |

Also, they have provided a proposal

* For SLS based methodology, the target performance for SLS is determined by the 5th percentile SINR value in CDF curve for different physical channels.

On the other hand, the agreement at RAN1#101-e says that “Note: the simulation assumptions for SLS are up to companies’ reports”. Considering the fact that small number of companies supports SLS for coverage analysis, it is not good idea to spend time on determining simulation assumptions for SLS. Therefore, the following moderator proposal can be made.

**Moderator’s proposal:**

* The agreement at RAN1#101-e remains: the simulation assumptions for SLS are up to companies’ reports, i.e. no more clarification is needed.

Companies are invited to provide their view on the moderator proposal above.

|  |  |
| --- | --- |
| Company | Comment |
| China Telecom | Support the moderator’s proposal. |
| OPPO | Support the moderator’s proposal. |
| CATT | Agree with the proposal. |
| ZTE | For SLS, most of the simulation assumptions can reuse that of defined for LLS. For the remaining very few SLS specific parameters, it’s fine for us to only note but not agree on detailed assumptions.  But, for the target performance of SLS, we believe this should be discussed together with the target performance for LLS based methodology. Actually it is once discussed in last meeting and seems no objections received at that time.  **Proposal:**  Identify the target performance and coverage bottlenecks based on target performance metric for FR1.   * FFS: the target performance metric and potential down selection. * Option 1: The target path loss is considered as the target performance.   + Alt1: Derived from the target ISD.   + Alt2: Relative MPL. * Option 2: ~~The target MCL~~ An MCL or MCL based metric is considered as the target performance.   + Alt1: Derived from the target ISD, considering shadow fading margin, penetration loss, etc.   + Alt2: Fixed target MCL, e.g. 147dB for VoIP to achieve better performance than other RAT(s).   + Alt3: Relative MCL * If optional SLS is performed, the target performance for SLS is determined by the 5th percentile SINR value in CDF curve for different physical channels * Other target performance metrics are not precluded. |
| Panasonic | We support the moderator’s proposal. |
| Intel | We are fine with FL’s proposal. |
| Ericsson | Some further clarification could help. For example, a 95% coverage target in system simulation (similar to ZTE’s comment) seems reasonable. |
| vivo | We agree with moderator’s proposal. |
| Apple | Generally, we are ok with FL’s proposal. We are wondering if we don’t have the common simulation assumption, how to calibrate the results? it seems that some companies propose the antenna array gain loss and interference modelling could need the inputs from SLS. |
| IITH, IITM, CEWIT, Reliance Jio, Tejas Networks | SUpport |
| Huawei, Hisilicon | It’s quite hard to converge the SLS parameter assumptions if SLS is included. |

**Summary of the discussion:**

* 9 companies support moderator’s proposal.
* 2 companies see the necessity for further clarification for SLS simulation assumptions

Moderator fully understands the usefulness of having common simulation assumption. However, given the number of interested companies, remaining issues and so on, it wouldn’t be good idea to spend on our time for this issue. Therefore, the following is proposed:

**Moderator’s updated proposal:**

* The agreement at RAN1#101-e remains: the simulation assumptions for SLS are up to companies’ reports

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | OK |
| ZTE | The target performance of SLS based methodology is more like an evaluation metric rather than a simulation assumption. Without clarifying this would cause incompleteness for the agreed SLS methodology. |
| vivo | We are fine with moderator’s proposal |

**Summary of the discussion:**

* 2 companies are OK for the moderator proposal
* 1 company proposes to clarify the target performance of SLS based methodology.

The number of interested companies on this issue is quite small. In addition, performance metric is one of the most controversial discussions, and hence large amount of time will be needed to conclude this discussion. Given this analysis, moderator would like to propose the following:

**Moderator’s updated proposal:**

* The agreement at RAN1#101-e remains: the simulation assumptions for SLS are up to companies’ reports
* The target performance of SLS based methodology, it is recommended to refer the agreements for LLS based methodology as much as possible.
* Note: these proposals are not necessary to be captured in the chairman’s note.

Interested companies are invited to provide your view on this proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Agree. |
|  |  |

**Summary of the discussion:**

Given no concern from companies, moderator would like to ask formal approval for the proposal:

**Moderator’s updated proposal:**

* The agreement at RAN1#101-e remains: the simulation assumptions for SLS are up to companies’ reports
* The target performance of SLS based methodology, it is recommended to refer the agreements for LLS based methodology as much as possible.
* Note: these proposals are not necessary to be captured in the chairman’s note.

## Final Confirmation - [M] Others

Some contributions propose to include additional simulation parameters in order to achieve a better performance.

* **(Item 1) Inter-slot frequency hopping**
  + Inter-slot frequency hopping should be used for rural [9]
* **(Item 2) Target error rate for PUSCH** 
  + the rural PUSCH baseline configuration should be with HARQ enabled and without restrictions on iBLER [9]
* **(Item 3) Use of MCS table for URLLC**
  + the qam64-LowSE MCS index table (table 3) shall be considered for the study of NR coverage enhancement. The maximum coverage of PUSCH shall be evaluated for the combination of number of allocated PRBs and MCS index which yields the largest MCL value. [3]
* **(Item 4) Combination on MCS and TBS**
  + The maximum coverage of PUSCH shall be evaluated for the combination of number of allocated PRBs and MCS index which yields the largest MCL value.[2]
* **(Item 5) Channel estimation for rural PUSCH**
  + The rural PUSCH baseline configuration should be with practical channel estimation , FFS: on configuration details (e.g. maximum time and frequency averaging) [9]
* **(Item 6) HARQ processes for TDD Voice**
  + For evaluation of uplink FR1 TDD VoIP, use at least 2 HARQ processes are used to prevent large accumulation in buffer [13]

**Moderator’s proposals**

* The proposals above will be added if sufficient number of positive comments is received.
* Even if they are not captured in the simulation assumption table, companies are still allowed to perform the simulations using these parameters.

Companies are invited to input their views on moderator’s proposal and proposed items 1-6.

|  |  |  |
| --- | --- | --- |
| Company | Item # | Comment |
| Nokia/NSB | 3,4 | These two items have a non-negligible impact on the code rate for PUSCH. A lower code rate implies a lower 10% BLER SINR, i.e., a longer range for the transmission. It seems only natural to consider these options as a baseline to assess the merit of possible PUSCH enhancements. Concerning item 3 in particular, it is true that this feature has been added to Rel-15 to provide URLLC support. However, it does not seem unreasonable to make use of it in other contexts as well, e.g., eMBB or VoIP, if this can deliver better transmission range in coverage limited settings (which need to operate at very low SINR). |
| Ericsson | 2 | We also expect HARQ and higher iBLER can improve performance vs fixed iBLER of 10%. |
| Qualcomm |  | We think it is sufficient for individual companies to report the various optimizations they have considered. No need for explicit agreements/proposals. |
| InterDigital | 6 | Similar to the analysis presented in TR 36.824, the latency requirements for VoIP need to be considered in the evaluation. The latency requirement of 50ms or 100ms will make a difference in coverage performance for VoIP, as shown in our contribution R1-2006243. In addition, the latency requirements will impose constraints on the number of repetitions and maximum transmissions. Therefore, the number of HARQ processes must be optimized to increase capacity to accept VoIP packets which are generated every 20ms. If we assume only one HARQ process for a long latency requirement, as pointed out in R1-2006242, the VoIP packets will start accumulating in the buffer at low. The issue must be dealt in both FDD and TDD and we believe the issue is critical for TDD given that there are not many uplink slots. Our proposal is to report the number of HARQ processes for evaluation of TDD VoIP, noting that the latency requirements of 50ms and 100ms should be considered when choosing the parameters for # of repetitions, # of HARQ processes and # of maximum retransmissions for TDD VoIP evaluations. |
| vivo | 1 | When considering repetition, inter-slot frequency hopping may need to be used |
| 2 | 10% BLER of eMBB PUSCH is already necessary to be enhanced, no need to consider a higher BLER. |
| 3,4 | It is too ideal to assume the best parameter combination, the network is less likely to have sufficient information and such a complicated scheduler to schedule PUSCH using the best combination, which would vary with the wireless channel and environments. |
| Apple | 3,4 | It could be better we have those two items at least for PDSCH evaluation. The assumptions on MCS and PRB for PDSCH from different companies are quite different. |
| Huawei, Hisilicon | 4 | Given a target data rate, different allocated PRBs and MCS combination will lead to different coverage performances. For baseline evaluation, a combination with best coverage performance should be used. |

**Summary of the discussion:**

There seems to be no big support for companies for all items. Since the checkpoint of this discussion is 8/26, moderator would like to propose to keep open for this discussion.

**Summary of the discussion on 8/25**

Based on the input from companies, only item 4 (for PUSCH) got the support from 3 companies. On the other hand, there is a concern from a company that it is not so easy to identify the best combination with the limited information at the scheduler. More importantly, we have so many open issues to be solved this week. We may not have time for this issue, which can be treated as “company to report”. Therefore, moderator would like to propose the following.

**Moderator’s proposal**

* For items 1-6 and MCS+PRB combination for PDSCH, RAN1 will not determine any specific values/assumptions
* Note: companies are still allowed to perform the simulations using these parameters/assumptions

Companies are invited to provide your view on this proposal.

|  |  |
| --- | --- |
| Company | Comment |
| InterDigital | Thank you very much for updating the proposal. Based on our previous input on item #6, we would like to make the following proposal, in addition to the moderator’s proposal.  **Proposal : Companies report latency requirements assumed in VoIP evaluation for TDD and FDD.**  Especially for TDD, given the agreed set of TDD configurations and 20ms generation VoIP packget arrival rate, we understand that it takes some effort to determine HARQ parameters in LLS to take advantage of the latency requirements agreed in RAN1#101e (50ms/100ms). We recognize that for some combinations of parameters, latency requirements other than 50ms/100ms need to be assumed to generate results. Therefore, we would like to make a proposal to clarify the assumption made in the evaluation. Reporting the latency requirements assumed in the evaluation will be beneficial to assess impact of latency requirements on the coverage performance for VoIP. |
|  |  |

**Summary of the discussion**

One comment is provided to item #6. From moderator sees the point of view, the proposal is quite reasonable, is useful for our analysis, and does not increase our simulation effort. Given this observation, moderator would like to update the following.

**Moderator’s updated proposal**

* For items 1-6 and MCS+PRB combination for PDSCH, RAN1 will not determine any specific values/assumptions
* latency requirements assumed in VoIP evaluation for TDD and FDD are reported by companies
* Note: companies are still allowed to perform the simulations using these parameters/assumptions

Companies are invited to provide your view on this proposal.

|  |  |
| --- | --- |
| Company | Comment |
| InterDigital | Thank you very much for updating the proposal. We support the proposal from the moderator. |

## Reminder for further discussions

Here is the list for further discussion, which is raised during the email discussion this week. This/These issues may be de-prioritized in this e-meeting because they are not related to simulation assumptions. Companies are encouraged to think about them more for the timely completion of this SI.

1. How to identify coverage bottleneck(s) ??
   1. For absolute target, coverage bottlenecks are identified when achieved MIL/MPL < absolute target.
   2. For relative target, coverage bottlenecks are identified when relative MIL/MPL compared to worst MIL/MPL > a target value

# Updated link budget analyses

Updated link budget analyses are shown in [2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22], and they have identified some potential bottleneck channels (e.g. PUSCH, PUCCH, PRACH). Since evaluation parameters have not fixed yet, any of the official agreements/observations shouldn’t be made. Hence, the following proposal can be made:

**Moderator’s proposal**

* The updated link budget analyses and the observations from each company are considered in our further study.

Please input your view to the following table, if any:

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | Support the proposal |
| Intel | We are fine with FL’s proposal. |
| NTT DOCOMO | We support FL proposal. |
| vivo | We agree with moderator’s proposal. |
| Huawei, Hisilicon | Support the moderator’s proposal |

# Summary of the proposals for the discussion on high priority items

## Moderator proposals for GTW on 8/20

[**2.3. [H] Open issue No.3 – link budget template (FR1 & FR2 common)**](#_[H]_Open_issue)

Most of the companies are OK to adopt the following proposal. On the other hand, 3 companies may still have a concern on this way forward. Their current position needs to be confirmed, whether or not they can live with it.

**Moderator’s proposal:**

* Adopt single link budget template based on IMT-2020 self-evaluation with new row(s) for MCL (and/or MIL) and necessary revisions, including adding/removing/revising some parameters.

[**2.2. [H] Open issue No.2 – CDL for link level simulation (FR1 only)**](#_[H]_Open_issue_1)

All the companies are OK or can (reluctantly) accept the following proposal. So it should be agreeable.

**Moderator’s proposal:**

* TDL models are used to generate results in the link budget templates
  + This does not preclude companies from performing the link-level simulations using CDL

[**2.4. [H] Open issue No.4 - antenna array gain (FR1 & FR2 common)**](#_[H]_Open_issue_2)

No company showed the concern on the following proposal. So it should be agreeable.

**Moderator’s proposal:**

* For the definition of antenna array gain, adopt option 1, i.e. Antenna array gain is included in the link budget template

[**3.1. [H] Definition of MCL, MIL and MPL (FR1 & FR2 common)**](#_[H]_Definition_of)

More discussion is necessary for this topic because companies’ is a bit diverse, and we still have 3 issues for discussion.

* For MCL, whether or not gNB antenna gain is included
  + Benefit of inclusion: MCL definition is aligned with that for TDL option 2 & CDL
  + Benefit of Exclusion: MCL definition is aligned with classic MCL (in 36.824) and that of IMT-2020
* For MPL, whether or not it is necessary
  + Reason to dropping it: MCL and MIL are sufficient to determine coverage and bottlenecks.
* MCL/MIL/MPL definition for TDL option 2 & CDL (mainly for FR2)
  + Not many input from companies
  + The discussion can be performed after the discussion on TDL Option 1 settles down.

**Moderator’s updated proposal:**

* **For TDL Option 1**
  + Definition of MCL
    - Total transmit power - Receiver sensitivity + [gNB antenna gain (component 2)]
  + Definition of MIL
    - Total transmit power - Receiver sensitivity + gNB antenna gain (component 2 + 3 + 4) + UE antenna gain
  + Definition of MPL
    - Total transmit power - Receiver sensitivity + gNB antenna array gain (component 2+3+4 for TDL option 1) + UE antenna gain - (8) Cable, connector, combiner, body losses (Tx side) - (20) Receiver implementation margin + (21a/b) H-ARQ gain - (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain - (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)



* **For TDL Option 2 and CDL**
  + Definition of MCL
    - Alt 2-1: Total transmit power - Receiver sensitivity
  + Definition of MIL
    - Total transmit power - Receiver sensitivity + gNB antenna gain (component 2 + 3) + UE antenna gain
  + Definition of MPL
    - Total transmit power - Receiver sensitivity + gNB antenna array gain (component 2+3 for TDL option 2 and CDL) + UE antenna gain - (8) Cable, connector, combiner, body losses (Tx side) - (20) Receiver implementation margin + (21a/b) H-ARQ gain - (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain - (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)



The following topic can be discussed if time available because any impact on simulation assumption is foreseen.

[**2.14. [H] Open issue No.14 - target performance metric (FR1 & FR2 common)**](#_[H]_Open_issue_3)

The latest moderator proposal is as following. The part in red is newly added to address the comment from the companies.

However, the proposal isn’t still close to the consensus because of the concerns raised by companies:

* We cannot make any decision on absolute target before checking the link budget analysis. So the discussion should be differed
* The achievable absolute value may be different due to the different parameters in the link budget template.
* Target ISD value is necessary for extreme long distance rural scenario is proposed. (We should check if operators are interested in it.)
* The target ISD value should be open.

Given the concerns above, there might be a possibility to move forward (even though this is a very small step) by removing the yellow shadow part of the moderator proposal. This can be quickly checked during the GTW session. If it is found that this proposal is not agreeable, we can go back to the email discussion again to avoid consuming online time.

**Moderator’s proposal:**

* RAN1 to strive for satisfying the operators requirements, which is given by absolute values:
  + For FR1 VoIP, MCL of 147dB and MCL/MPL/MIL derived from ISD of 500m for urban and 1732m for rural
    - Note: the definition of MCL above does not include antenna gain. The value will be adjusted depending on the definition of MCL
  + For FR1 eMBB, MCL/MPL/MIL derived from ISD of 500m for urban and 1732m for rural
  + (For FR2, companies input are encouraged)
* Continue discussion whether or not / how much coverage enhancements beyond the operators’ requirements will be performed.
  + Link budget template is used for this analysis
  + Complexity, spec impact, power consumption are taken into account
* The link budget template should include the all the potential performance metrics, i.e. MCL, MPL, MIL

## Stataus after GTW session on 8/20

**Proposal:**

* Adopt single link budget template for both FR1 and FR2 based on IMT-2020 self-evaluation with new row(s) for MCL (and/or MIL) and necessary revisions, including adding/removing/revising/simplifying some parameters
  + Aim to conclude the necessary revisions by the end of this e-meeting

Agreements:

* TDL models are used to generate results in the link budget templates for FR1
  + This does not preclude companies from performing the link-level simulations using CDL

Agreements (for both FR1 & FR2):

* For the definition of antenna array gain, adopt option 1, i.e. Antenna array gain is included in the link budget template, where there are four antenna gain components
  + Note: the four components are illustrated below – the figure is for illustration purpose only
  + FFS which component(s) are NOT part of the definition of antenna array gain
* 

Agreements:

* For TDL Option 1
  + Definition of MCL
    - Total transmit power - Receiver sensitivity + gNB antenna gain (component 2)
  + Definition of MIL
    - Total transmit power - Receiver sensitivity + gNB antenna gain (component 2 + 3 + 4) + UE antenna gain
  + Definition of MPL
    - Further discussion offline the definition using below as a starting point:
      * Total transmit power - Receiver sensitivity + gNB antenna array gain (component 2+3+4 for TDL option 1) + UE antenna gain - (8) Cable, connector, combiner, body losses (Tx side) - (20) Receiver implementation margin + (21a/b) H-ARQ gain - (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain - (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)
  + Note: whether/how to use the above definitions is to be discused

## Moderator proposals for GTW on 8/24

[**2.3. [H] Open issue No.3 – link budget template (FR1 & FR2 common)**](#_[H]_Open_issue)

For link budget template & target performance metric issue, moderator has propose a way forward, and this was discussed under email discussion [102-e-NR-CovEnh-01]. Moderator would like to ask to approve this proposal, which was modified as below.

**Moderator’s proposal:**

* Adopt single link budget template for both FR1 and FR2 based on IMT-2020 self-evaluation with rows for MIL, MCL, MPL, and necessary revisions, including adding/removing/revising/simplifying some parameters
* [For LLS based methodology, ] coverage bottleneck(s) identification is performed using at least [MCL and] MIL.
  + [MCL values can also be considered to compare channels with similar antenna (and antenna array) gain]
* MPL ~~is kept in the link budget table and~~ can be used as supplemental information for coverage bottleneck(s) identification
  + The results based on MPL are to be captured in TR and the intention is to show the achievable ISD for information.
  + The definition of MPL shall be determined in RAN1
  + RAN1 will not agree on specific values for the parameters related to MPL
    - IMT-2020 values can be a starting point, but companies may use other values.
* RAN1 strives for satisfying targets identified by operators
  + They are expressed in the form of:
    - 1. Scenario dependent ISD/MPL targets;
    - 2. Service dependent MCL targets, e.g., [147] dB for VoIP;
    - 3. Relative MIL(/MCL) difference between channels.
* Further values and details of such targets will be clarified at RAN1#103-e, which means that operators are encouraged to prepare a joint proposal.
* Note: Study item objectives are according to the study item description, and not changed in RAN1 by the targets.

[**3.1. [H] Definition of MCL, MIL and MPL (FR1 & FR2 common)**](#_[H]_Definition_of)

Given the way forward above, moderator doesn’t see any strong reason to apply further simplification for MPL definition because RAN1 will not spend our time on value determination and our analysis is primarily performed by using MIL. The existing definition in the IMT-2020 template can be reused for MPL. Also for TDL option 2 & CDL, the same (or equivalent) definition as TDL option 1 should apply. I therefore would propose the following.

**Moderator’s proposal:**

* Definition of MPL
  + Total transmit power - Receiver sensitivity + gNB antenna array gain (component 2+3+4 for TDL option 1) + UE antenna gain - (8) Cable, connector, combiner, body losses (Tx side) - (20) Receiver implementation margin + (21a/b) H-ARQ gain - (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain - (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)
* Definition of MCL, MIL and MPL for TDL Option 2 and CDL
  + Definition of MCL
    - Total transmit power - Receiver sensitivity
  + Definition of MIL
    - Total transmit power - Receiver sensitivity + gNB antenna gain (component 2 + 3) + UE antenna gain
  + Definition of MPL
    - Total transmit power - Receiver sensitivity + gNB antenna array gain (component 2+3 for TDL option 2 and CDL) + UE antenna gain - (8) Cable, connector, combiner, body losses (Tx side) - (20) Receiver implementation margin + (21a/b) H-ARQ gain - (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain - (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)



## Stataus after GTW session on 8/24

Agreements:

* Adopt single link budget template for both FR1 and FR2 based on IMT-2020 self-evaluation with rows for MIL, MCL, MPL, and necessary revisions, including adding/removing/revising/simplifying some parameters
  + [For LLS based methodology, ]coverage bottleneck(s) identification is performed using at least [MCL and] MIL.
  + [MCL values can also be considered to compare channels with similar antenna (and antenna array) gain]

Agreements:

* MPL can be used as supplemental information for coverage bottleneck(s) identification
* The results based on MPL are to be captured in TR
  + Note: this is uself to show the achievable ISD.
* The definition of MPL shall be determined in RAN1
* RAN1 will not further discuss on specific values for the parameters related to MPL
  + IMT-2020 values are as a starting point, but:
    - companies may use other values, and
    - for the parameters that companies think IMT-2020 self-evaluation does not clearly define the values for some scenarios, it is up to companies to report

Agreements:

* RAN1 strives for satisfying appropriate targets identified by companies particularly operators
  + The targets may be in the form of one or more of the following:
    - 1. Scenario dependent targets, e.g., ISD/MPL
    - 2. Service dependent targets, e.g., [MCL=147] dB for VoIP;
    - 3. Relative difference between channels, e.g, MIL(/[MCL])
  + Further values and details of such targets will be clarified at RAN1#103-e
  + Note: there is no intention in RAN1 to update the study item objectives due to the identified targets.

# Summary of the proposals for the discussion on remaining high priority & middle priority items

To be incorporated later.

# Summary of the proposals for the discussion on remaining items

To be incorporated later.

# Summary of the agreements

To be incorporated later.

# References

1. R1-2006242 Discussion on simulation assumptions for VoIP InterDigital, Inc.
2. R1-2005256 Evaluation on the baseline performance for FR1 Huawei, HiSilicon
3. R1-2005297 Baseline coverage evaluation of UL and DL channels – FR1 Nokia, Nokia Shanghai Bell
4. R1-2005393 Evaluation on NR coverage performance for FR1 vivo
5. R1-2005425 Discussion on baseline coverage performance for FR1 ZTE
6. R1-2005722 Baseline coverage performance for FR1 CATT
7. R1-2005731 Baseline performance for NR coverage enhancements for FR1 China Telecom
8. R1-2005887 Discussion on baseline coverage performance for FR1 Intel Corporation
9. R1-2005939 FR1 PUSCH Coverage Performance Sierra Wireless, S.A.
10. R1-2006045 Evaluation on NR coverage performance for FR1 OPPO
11. R1-2006160 Baseline coverage performance using LLS for FR1 Samsung
12. R1-2006224 Discussion on the baseline performance in FR1 CMCC
13. R1-2006243 FR1 baseline coverage performance using LLS InterDigital, Inc.
14. R1-2006990 Baseline coverage performance analysis in FR1 Panasonic Corporation
15. R1-2006455 Baseline coverage performance for uplink Indian Institute of Tech (H)
16. R1-2006530 Evaluation on FR1 coverage performance Apple
17. R1-2006534 Baseline coverage performance for FR1 Xiaomi Technology
18. R1-2006578 Evaluation results of coverage for FR1 Urban scenario Sharp
19. R1-2006611 Link and System Evaluation of Coverage for FR1 Ericsson
20. R1-2006645 Views on target performance metric and values for FR1 coverage enhancements SoftBank Corp.
21. R1-2006652 Baseline coverage performance for FR1 Charter Communications
22. R1-2006739 Baseline coverage performance for FR1 NTT DOCOMO, INC.
23. R1-2006818 Baseline FR1 coverage performance Qualcomm Incorporated
24. R1-2005259 Discussions on simulation assumptions for VoIP Huawei, HiSilicon
25. R1-2005303 Evaluation assumptions for NR coverage enhancement evaluation Nokia, Nokia Shanghai Bell
26. R1-2005398 Considerations on Evaluation Assumptions for Coverage Enhancements vivo
27. R1-2005430 Discussion on evaluation methodology for NR coverage ZTE
28. R1-2005727 Discussion on the methodology for baseline coverage performance using LLS CATT
29. R1-2005733 Remaining issues on evaluation methodology for NR coverage enhancements China Telecom
30. R1-2005892 Discussion on simulation assumptions for NR coverage enhancement Intel Corporation
31. R1-2006050 Functionality of Coverage Enhancement and other SI/WI OPPO
32. R1-2006293 Reducing PDCCH load of coverage-limited UEs InterDigital, Inc.
33. R1-2006616 Evaluation methodology for coverage enhancements Ericsson
34. R1-2006823 Other coverage enhancement aspects Qualcomm Incorporated

# Annex – Agreements at RAN1#101e

Update on 6/1: to check 6/2

Update from 6/4 GTW:

Agreements:

* Adopt the following target data rates for eMBB performance evaluation for FR1.
* Urban scenario: DL 10Mbps, UL 1Mbps
* Rural scenario: DL 1Mbps, UL 100kbps
* Rural with long distance scenario: DL 1Mbps, UL 100kbps, ~~[~~30kbps~~]~~ (optional)

**Agreements:**

* For VoIP performance evaluation based on link-level simulation for FR1.
* A packet size of [320] bits with 20ms data arriving interval is adopted.
* ~~FFS~~TBD: TBS for SIP invite message. Payload of 1500 bytes can be a starting point.

Agreements:

* The basic evaluation methodology is based on link-level simulation for FR1.
* Step 1: Obtain the required SINR for the physical channels under target scenarios and service/reliability requirements.
* Step 2: Obtain the baseline performance based on required SINR and link budget template.
* Note: asepcts related to identifying target performance and coverage bottlenecks based on target performance metric is to be handled separately
* ~~FFS:~~ The evaluation methodology based on system-level simulation is optional for FR1.
* Note: The simulation assumptions for SLS are up to companies’ reports.

Agreements:

* For link level simulation, adopt the following table for PUSCH and PUCCH for FR1.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Scenario and frequency | Urban: 4GHz (TDD), 2.6GHz (TDD)  Rural: 4GHz (TDD), 2.6GHz (TDD), 2GHz (FDD), 700MHz (FDD)  Rural with long distance: 700MHz (FDD), 4GHz (TDD) |
| Frame structure for TDD | DDDSU (S: 10D:2G:2U) only for 4GHz  DDDSUDDSUU (S: 10D:2G:2U) only for 4GHz  DDDDDDDSUU (S: 6D:4G:4U) only for 2.6GHz  Other frame structures can be reported by companies. |
| Pathloss model (select from LoS or NLoS) | Urban: NLoS  Rural: NLoS and LoS |
| BWP | 100MHz for 4GHz and 2.6GHz.  20MHz for 2GHz (FDD  20MHz (optional for 10MHz) for 700MHz. (FDD) |
| SCS | 30kHz for TDD, 15kHz for FDD. |
| Channel model for link-level simulation | TDL-C for NLOS, TDL-D for LOS.  [CDL] |
| UE velocity | Urban: 3km/h for indoor  Rural: 3km/h for indoor, 120km/h (optional 30km/h) for outdoor |
| Frequency hopping | w/ or w/o ~~Intra-slot~~ frequency hopping for PUSCH  w/ frequency hopping for PUCCH ~~is enabled~~. |

* FFS whether there are any additional simulation considerations for the extreme coverage scenarios (e.g., rural)

Update on 6/5:

Agreement:

* Down selection on the following options for the link budget template for FR1 in next meeting.
* Option 1: Adopt single link budget template based on IMT-2020 self-evaluation with necessary revisions, including adding/removing/revising some parameters.
  + FFS: The template provided by FL in Tdoc [R1-2005005](file:///D:\2020年度工作\RAN1%23102\during%20the%20meeting\Docs\R1-2005005.zip).
* Option 2: Adopt both templates, i.e. link budget template in IMT-2020 self-evaluation and link budget template in TR 36.824.
* Option 3: Adopt single link budget template in TR 36.824 with necessary revisions, including adding/revising some parameters.

Agreement:

Down selection on the following options for antenna array gain for LLS based methodology for FR1 in next meeting.

* Option 1: Antenna array gain is included in the link budget template.
* FFS: array gain = 10 \* 1og10 (number of antenna elements/number of TxRUs)
* FFS: For TDL channel model
* FFS: Values reflective of realistic implementation and network operation.
* Option 2: Antenna array gain is included in LLS.
* FFS: For CDL channel model

Agreement:

* For link level simulation, adopt the following table for PDSCH for FR1.

|  |  |
| --- | --- |
| Parameters | Values |
| Waveform | CP-OFDM |
| PRBs/MCS/TBS | Reported by companies. |
| PDSCH duration | 12 OS |
| Other parameters | FFS |

Agreements:

* For link level simulation, adopt following TBS for Msg3 for FR1
* 56 bits

Agreements:

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

Agreements:

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

Agreements:

* The evaluation methodology for FR2 is the same as FR1.

Agreements:

* The link budget template for FR2 is the same as FR1.

Agreements:

* 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)  Other frame structures can be reported by companies. |
| Subcarrier Space | 120kHz |
| UE velocity | Indoor scenario:3km/h  Urban scenario: 3km/h for indoor, 30km/h for outdoor.  Suburban scenario: 3km/h for indoor, 30km/h, (optional: 120km/h) for outdoor. |
| Occupied channel bandwidth for | 100MHz, [400MHz] |
| Frequency hopping for PUSCH | w/ or w/o frequency hopping |

Final summary in R1-2005004.

**//Update on 6/7, post e-Meeting additional email approval**

**[101-e-Post-NR-Cov-Enh] Email discussion/approval focusing on remaining evaluation assumptions till 6/17 – Jianchi (CT)**

* **Focusing on high priority proposals first, target 6/11 for early approvals**
* **Followed by medium priority/low priority proposals**

Update on 6/11: check on 6/12 for potential agreements

Update on 6/12:

Agreements

* For link level simulation, adopt the following table for PUSCH for eMBB data or VoIP for FR1.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| BLER for PUSCH | For eMBB,  w/ HARQ, 10% iBLER;  w/o HARQ, 10% iBLER.  For VoIP, 2% rBLER. |
| Number of UE transmit chains for PUSCH | 1，2 (optional) |
| DMRS configuration for PUSCH | For 120km/h, (Optional: 30km/h): Type I, 2 or 3 DMRS symbol, no multiplexing with data.  For frequency hopping: Type I, 1 or 2 DMRS symbol for each hop, no multiplexing with data.  PUSCH mapping Type and DMRS position are reported by companies.  Working assumption:  For 3km/h: Type I, 1 or 2 DMRS symbol, no multiplexing with data. |
| Waveform for PUSCH | DFT-s-OFDM,  CP-OFDM (optional) |
| Repetitions for PUSCH | For eMBB,  w/o repetition as baseline,  w/ repetition (optional).  For VoIP, w/ repetition.  The actual number of repetitions is reported by companies.  FFS: Repetition type B |
| HARQ configuration for PUSCH | For eMBB, whether HARQ is adopted is reported by companies.  For VoIP, w/ HARQ.  The maximum number of HARQ transmission (limited by frame structure and latency requirements) can be reported by companies. |
| Latency requirements for voice | 50ms/100ms |
| PUSCH duration | 14 OS |

Agreements

* For link level simulation, adopt the following table for PUCCH for FR1.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| PUCCH format type | Format 1, 2bits UCI.  Format 3, [4bits (3 bits A/N + 1 bit SR)]/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:  BLER for Ack/Nack, SR: 1%  FFS: BLER for CSI (10% or 1%) |
| Number of PRBs for PUCCH | 1 PRB |
| Number of UE transmit chains for PUCCH | 1 |
| Number of repetitions for PUCCH | w/ repetition (optional), w/o repetition for PUCCH.  The maximum number of repetitions is 8. |
| PUCCH duration | 14 OS |
| DMRS configuration for PUCCH | FFS: number of DMRS symbols for PUCCH Format 3. |

Agreements:

* For link level simulation, adopt the following table for eMBB data or VoIP on PUSCH and for PUCCH for FR1.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Number of ~~receive~~ antenna elements for BS | Urban: 192 antenna elements for 4GHz and 2.6GHz,  (M,N,P,Mg,Ng) = (12,8,2,1,1)  (optional) 128 antenna elements for 4GHz,  (M,N,P,Mg,Ng) = (8,8,2,1,1)  Rural: 64 antenna elements for 4GHz and 2.6GHz  (M,N,P,Mg,Ng) = (8,4,2,1,1)  32 antenna elements for 2GHz  (M,N,P,Mg,Ng) = (8,2,2,1,1)  16 antenna elements for 700MHz  (M,N,P,Mg,Ng) = (4,2,2,1,1) |
| Number of ~~receive~~ TxRUs for BS | ~~TBD~~  gNB architectures to study ~~for TDL~~:   * 2 or 4 TXRUs for 2GHz, 700 MHz * 64TxRUs for 2.6 and 4 GHz. * Optional: 32 TXRUs at 2 GHz   ~~[~~gNB modeling in LLS for TDL:   * Option 1: 2 or 4 gNB receive chains in LLS ~~(as starting point)~~. FFS: correlation * Option 2: Number of gNB receive chains = number of TXRUs in LLS. FFS: correlation.~~]~~   [gNB architectures to study for CDL:   * Urban: 64 receive chains for 2.6 and 4 GHz in LLS * Rural: 8 receive chains for 4GHz and 2.6GHz in LLS * 4 receive chains for 2GHz and 700MHz in LLS.]   [gNB modeling in LLS for CDL:   Number of gNB receive chains = number of TXRUs in LLS.] |
| Delay spread | Urban: 300ns  Rural: 300ns  Rural with long distance: 30ns |
| PRBs/TBS/MCS for eMBB for PUSCH | Any value of PRBs, and corresponding MCS index, reported by companies will be considered in the discussion. Companies are encouraged to use 30 PRBs for 1Mbps, 4 PRBs for 100kbps, 1 PRB for 30kbps as a starting point.  TBS can be calculated based on e.g. the number of PRBs, target data rate, frame structure and overhead. |
| PRBs/MCS for VoIP for PUSCH | [4 PRBs] for VoIP as starting point.  Other values of PRBs can be reported by companies.  QPSK, pi/2 BPSK (optional) |

Note: For TDL models, companies report whether antenna array gain, ~~obtained from mapping antenna elements to TXRU,~~ is included in LLS or link budget template. Array gain calculation method and how channel estimation is accounted for is reported by companies

Agreements:

* Adopt the following target data rates for eMBB performance evaluation for FR2.
* Indoor: DL: 25Mbps, UL:5Mbps
* Urban: DL: 25Mbps, UL: 5Mbps
* Suburban: FFS: (DL: 1Mbps, UL: 50kbps)

Other proposals?

* # Number of receive TxRUs for BS – 6/15
* Others?

Update on 6/17

Regarding # Number of receive TxRUs for BS – see the update of the agreement above.

Agreements:

* ~~For link level simulation, adopt the following table for SSB for FR1.~~

|  |  |
| --- | --- |
| **~~Parameters~~** | **~~Values~~** |
| ~~Periodicity~~ | ~~20ms~~ |
| ~~Performance metric~~ | ~~Combination of 4 SSBs in 80ms.~~ |
| ~~Other parameters~~ | ~~Reported by companies.~~ |

* For link level simulation, adopt the following table for Msg.3 for FR1.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Number of PRBs | 2 |
| Waveform | DFT-s-OFDM |
| Number of DMRS symbol | w/o frequency hopping: 3,  w/ frequency hopping: 2 for each hop |
| PUSCH duration | 14 OS |
| Other parameters | Reported by companies. |

Other proposals 6/18

Update on 6/18:

Agreements:

* For link level simulation, adopt the following table for PDCCH for FR1.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Aggregation level | 16 |
| Payload | 40 bits |
| CORESET size | 2 symbols, 48 PRBs |
| Tx Diversity | Reported by companies |
| BLER for PDCCH | 1% BLER  FFS: 10% BLER |
| Number of SSB for broadcast PDCCH of Msg.2 | Reported by companies |
| Other parameters | Reported by companies |

Agreements:

* For link level simulation, adopt the following table for SSB for FR1.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Periodicity | 20ms |
| Performance metric | Combination of 4 SSBs in 80ms.  Note: UE is not assumed to know the SS/PBCH block index |
| Other parameters | Reported by companies. |

Agreements:

* For link level simulation, adopt the following table for PRACH for FR1.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Format | Format 0, Format B4, or Format C2 |
| SCS | Reported by companies. |
| Performance metric | 1% missed detection at 0.1% false alarm probability  FFS: 10% missed detection. |
| Other parameters | Reported by companies. |

Agreements:

* For link level simulation, for PDSCH of Msg.4 for FR1.
  + Reuse the following simulation assumption for PDSCH
    - Waveform, [PDSCH duration]
  + FFS: Payload size: [3000bits].
  + Other parameters: Reported by companies.

Agreements:

* For link level simulation, for SSB, PDCCH, PDSCH and PDCCH of Msg.2, PDSCH of Msg.4 and PDSCH for FR1.
  + Reuse following simulation assumptions agreed for PUSCH.
    - Scenario and frequency, frame structure, SCS, pathloss model, channel model, delay spread, UE velocity, number of antenna elements and TxRUs for BS.
  + The number of UE receive chains: ~~is 2.~~
    - 4 for 4GHz/2.6GHz
    - 2 or 4 for 2GHz
    - 2 for 700MHz
  + For PDSCH, reuse ~~DM-RS configuration,~~ BLER, HARQ, Latency requirements for voice agreed for PUSCH.
    - Reuse DM-RS configuration agreed for PUSCH except that 3 DMRS symbols is used for Msg2.
* For link level simulation, for PRACH and Msg.3 for FR1.
  + Reuse following simulation assumptions agreed for PUSCH
    - Scenario and frequency, frame structure, pathloss model, channel model, delay spread, UE velocity, number of antenna elements and TxRUs for BS and Number of UE transmit chains.
  + For Msg.3, reuse SCS, HARQ configuration, frequency hopping agreed for PUSCH.

Agreements:

* For link level simulation, adopt the following table for eMBB data or VoIP on PUSCH and on PDSCH for FR2.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| BLER | For eMBB,  w/ HARQ, 10% iBLER, Optional: companies report rBLER.  w/o HARQ, 10% iBLER.  For VoIP, 2% rBLER. |
| DMRS configuration | For 30km/h (optional: 120km/h): Type I, 2 or 3 DMRS symbol, no multiplexing with data.  For frequency hopping for PUSCH: Type I, 1 or 2 DMRS symbol for each hop, no multiplexing with data.  PUSCH/PDSCH mapping Type and DMRS position are reported by companies.  Working assumption:  For 3km/h: Type I, 1 or 2 DMRS symbol, no multiplexing with data. |
| Waveform | DFT-s-OFDM for PUSCH, CP-OFDM for PDSCH  FFS: CP-OFDM for PUSCH |
| Repetitions for PUSCH/PDSCH | For eMBB,  w/o repetition as baseline,  w/ repetition (optional).  For VoIP, w/ repetition.  The actual number of repetitions is reported by companies.  FFS: Repetition type B for PUSCH. |
| HARQ configuration for PUSCH/PDSCH | For eMBB, whether HARQ is adopted is reported by companies.  For VoIP, w/ HARQ.  The maximum number of HARQ transmission (limited by frame structure and latency requirements) can be reported by companies. |
| PUSCH/PDSCH duration | 14 OS for PUSCH, 12 OS for PDSCH |

Agreements:

* For link level simulation, adopt the following table for eMBB data or VoIP on PUSCH and on PDSCH for FR2.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Number of antenna elements for BS | Indoor scenario: 128  (M, N, P, Mg, Ng) = (8, 8, 2, 1, 1)  Urban/suburban scenario:  256, (M,N,P,Mg,Ng) = (4, 8, 2, 2, 2)  Optional: 512, (M,N,P,Mg,Ng) = (8,8,2,2,2) |
| Number of TxRUs for BS | 2  Note: Analog beamforming is assumed. |
| Number of UE Tx/Rx chains | 1T2R, 2T2R |
| Channel model for link-level simulation | CDL- A, TDL-A, [urban/suburban: TDL-C]  Note: company can provide simulation results based on either TDL channel or CDL model |
| Delay spread | Indoor scenario: 30ns  Urban scenario: 100ns  Suburban scenario: 100ns |
| Latency requirements for voice | 50ms/100ms |
| PRBs/TBS/MCS for eMBB for PUSCH/PDSCH | Any value of PRBs, and corresponding MCS index, reported by companies will be considered in the discussion. Companies are encouraged to use [30] PRBs for 5Mbps for PUSCH and full bandwidth for 25Mbps for PDSCH as a starting point.  TBS can be calculated based on e.g. the number of PRBs, target data rate, frame structure and overhead. |
| PRBs/MCS for VoIP for PUSCH/PDSCH | [4 PRBs] for VoIP as starting point. Other values of PRBs can be reported by companies.  QPSK for PDSCH/PUSCH  Optional: pi/2 BPSK for PUSCH |

Agreements:

* For link level simulation, adopt the following simulation assumption for eMBB data or VoIP on PUSCH and on PDSCH for FR2.

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Number of UE antenna elements | 8, one panel:(M, N, P) = (2,2,2),  FFS: Two panels in link budget, one panel in LLS, 16 for each panel: (M, N, P) = (4,2,2) |

Agreements:

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

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Format | Format 1, 2bits UCI.  Format 3, [4bits (3 bits A/N + 1 bit SR)]/11/22 bits UCI  FFS: Format 0, 2 |
| BLER for PUCCH | The same as FR1 |
| Number of PRBs for PUCCH | The same as FR1 |
| Number of UE transmit chains for PUCCH | The same as FR1 |
| Number of repetitions for PUCCH | The same as FR1 |
| PUCCH duration | 14 OFDM symbols  FFS: 4 OFDM symbols |
| DMRS configuration for PUCCH | FFS: [4] DMRS symbols for PUCCH Format 3. |

Agreements:

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

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Aggregation level | 16 |
| Payload | 40 bits |
| CORESET size | 2 symbols, 48PRBs |
| Tx Diversity | Reported by companies |
| BLER for PDCCH | 1% BLER.  FFS: 10% BLER |
| Number of SSB for broadcast PDCCH of Msg.2 | Reported by companies |
| Other parameters | Reported by companies |

Agreements:

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

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Format | Format B4, (Optional: Format C2) |
| SCS | Reported by companies. |
| Performance metric | 0.1% false alarm, 1% miss-detection  FFS: 10% missed detection. |
| Number of SSB beams | Reported by companies |
| Other parameters | Reported by companies. |

Agreements:

* For link level simulation, for SSB, PDCCH, PDSCH and PDCCH of Msg.2, PDSCH of Msg.4 for FR2.
  + Reuse following simulation assumptions for PDSCH
    - Scenario and frequency, frame structure, SCS, channel model, delay spread, UE velocity, number of antenna elements and TxRUs for BS, number of UE Tx/Rx chains and UE antenna elements.
* For link level simulation, for PUCCH, PRACH and Msg.3 for FR2.
  + Reuse following simulation assumptions for PUSCH
    - Scenario and frequency, frame structure, channel model, delay spread, UE velocity, number of antenna elements and TxRUs for BS, number of UE antenna elements for PUSCH.
  + For PRACH and Msg.3, reuse number of UE Tx chains for PUSCH.
  + For PUCCH, reuse SCS for PUSCH.
  + For Msg.3, reuse SCS, HARQ configuration, frequency hopping for PUSCH.

Final summary in R1-2005192.