3GPP TSG-RAN WG2 Meeting #121bis-e, R2-230xxxx

17 – 26 April 2023

**Agenda item: 7.24.2**

**Source: Vodafone (Rapporteur)**

**Title: [AT121bis-e][412][POS] GNSS LOS/NLOS information**

**WID/SID: TEI-18**

**Document for: Discussion and Decision**

# 1 Introduction

This document is the report of the following email discussion:

* [AT121bis-e][412][POS] GNSS LOS/NLOS information (Vodafone)

      Scope: Discuss documents R2-2303163 / R2-2303196 / R2-2303200 / R2-2303206 and attempt to bring the CRs to an agreeable condition.

      Intended outcome: Report and agreeable CRs

      Deadline: Friday 2023-04-21 1000 UTC

**Phase 1 deadline of Thursday 2023-04-20 10:00 AM UTC for all company comments.**

Phase 2 deadline of Friday 2023-04-21 10:00 UTC AM for final agreed CRs.

Documents for the discussion:

[1] R2-2303163 GNSS LOS/NLOS assistance information-Follow up Vodafone, Spirent, Ericsson, Telecom Italia discussion Rel-18

[2] R2-2303196 GNSS LOS/NLOS assistance information Vodafone, Spirent, Ericsson, Telecom Italia CR Rel-18 37.355 17.4.0 0436 - B TEI18

[3] R2-2303200 GNSS LOS/NLOS posSIB broadcast assistance information Vodafone, Spirent, Ericsson, Telecom Italia CR Rel-18 38.331 17.4.0 3998 - B TEI18

[4] R2-2303206 GNSS LOS/NLOS posSIB broadcast assistance information Vodafone, Spirent, Ericsson, Telecom Italia CR Rel-18 36.331 17.4.0 4923 - B TEI18

# 2 Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

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| --- | --- | --- |
| Company | Name | Email Address |
| Vodafone (Rapporteur) | Alexey Kulakov | Alexey.Kulakov@vodafone.com |
| Ericsson | Fredrik Gunnarsson | fredrik.gunnarsson@ericsson.com |
| OPPO | Yang Liu | liuyangbj@oppo.com |
| Vodafone | Alexey Kulakov | Alexey.Kulakov@vodafone.com |
| CATT | Jianxiang Li | lijianxiang@catt.cn |
| Spirent | Paul Hansen | paul.hansen@spirent.com |
| Intel | Yi Guo | Yi.guo@intel.com |
| Lenovo | Hyung-Nam Choi | hchoi5@lenovo.com |
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# 3 Discussion

Discussion Document in R2-2303163[1] :

**Question 1**: Do you have any technical comments to the scope highlighted in R2-2303163. Please elaborate your opinion.

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| Answers to Question 1 | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | No | We have no technical arguments against but a few comments: - the document describes in detail how a device can use and benefit from the provided LoS/NLoS information also when it has an uncertain position estimate – referred to the chicken-egg situation at the last meeting  - the document also makes clear that the feature does not need a precise position from the device reported  - there are also some size assessments made  Thereby, we think the questions raised online in Athens have been addressed |
| OPPO |  | It seems that R2-2303163 only states that the LOS/NLOS information is provided for the 2-D grid points in the real-time uncertain area, but not related with the 3-D altitude (height) point as indicated in the following stage-3 CR. My first question is that is the 3-D altitude necessary or not?  Also, in R2-2303163, the author states that the UE could ask for a finer granularity grid LOS information when the accuracy of the positioning result becomes better and the uncertain area shrinks. My second question is: how to achieve this by using the broadcast method? Only limited size of info could be conveyed to UE via broadcast |
| Vodafone | Yes | The attitude is a part of stage 3 CRs, and also included into the grid data:  LoS-NLoS-GridPoints.  The description of the LoS-NLoS GridPoints field includes 3 different elements which are used together to determine the altitude of each layer of data contained within the GridPoints.  **referenceAltitudeType**  This field specifies the type of altitude reference that is used to describe the altitude properties of the grid.  – i.e. the height datum that is uses as the reference for all altitude values, for example the WGS84 ellipsoid.  **referenceAltitude**  This field specifies the altitude of the upmost layer of the grid, where the altitude is in relation to the level defined by the *referenceAltitudeType*  The corresponding field description can be improved  **stepAltitude**  This field specifies the difference in altitude between the upper and lower altitude layer both are present in the grid. If this field is not present, the grid represents only one altitude layer. The values n05, n1, n2, n3, n4, n5, n10, n20 encode 0.5, 1, 2, 3, 4, 5, 10, 20 meters respectively.  - i.e. the separation (in meters) of the different layers of grid points that are provided.  Used together, these 3 elements will uniquely define the altitude value for the grid points.  The option to provide grid data via SIB is introduced because some companies believed that for some use case, it would be sufficient to rely on SIB only. Anyhow it does not forbid the UE to request more granular information once received the SIB with initial grid data. |
| CATT | No | The explanation of GNSS RECEIVER WITH LOS/NLOS IMPLEMENTATION sounds clear and fair enough. |
| Spirent | No | Agree with Ericsson. |
| Intel | No | Agree with Ericsson and Vodafone. |
| Lenovo | No |  |
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**Summary 1**: One company provided a comment to the determination of attitude. According to the proponents of the feature, referenceAltitudeType, referenceAltitude, stepAltitude

**Proposal 1:** As no other general questions (except of 1 which was clarified) were received, it is proposed to discuss all other detailed technical aspects within Stage 3 discussion.

**Second Round:**

**Do you agree with Moderator proposal 1:**

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| Answers to Question 2 | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | Yes |  |
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**Question 2:** Please provide your view on the proposal in R2-2303163: It is proposed to proceed with the definition of stage 3 details to support LOS/NLOS information as described in R2-2303196, R2-2303200, R2-2303206

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| Answers to Question 2 | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | Yes | We think the motivations in the discussion paper are sound and relevant and are fine to proceed with stage 3 |
| CATT | Yes | We agree to review the Stage-3 CRs in details. |
| Vodafone | Yes | Agree with CATT |
| Spirent | Yes | Agree with CATT and Vodafone. |
| Intel | Yes | Agree with Ericsson and other companies. |
| Lenovo |  | We can proceed with stage 3 but we wonder whether stage 2 updates are needed as well. |
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**Summary 2**: 6 companies are fine to proceed with stage 3 CRs. 1 company is wondering if stage 2 description is needed

**Proposal 2**: It is a moderator understanding that companies participated in the email are fine to introduce LOS/NLOS feature to Rel. 18 and therefore it is proposed to proceed with stage 3 details to support LOS/NLOS information based on in R2-2303196, R2-2303200, R2-2303206

**Second Round:**

**Do you agree with Moderator proposal 2:**

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| Answers to Question 2 | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | Yes | A stage 2 description is also relevant but can be added once the stage 3 details have converged |
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CR in R2-2303196 [2] for 37.355

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| ***Reason for change:*** | The determination of the accuracy is one of the major tasks of GNSS receiver and the increased accuracy is very important especially in the multi-path environment like urban canyon for many use cases. In order to achieve it, the assistance information of Line of Sight (LOS) / Non Line of Sight (NLOS) of satellites of a particular satellite in a given location is required to assist GNSS receiver |
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| ***Summary of change:*** | The support of assistance information about LOS/NLOS GNSS satellites, corresponding UE capability and the information to request LOS/NLOS GNSS satellites assistance data are introduced |
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| ***Consequences if not approved:*** | There is no assistance information about LOS/NLOS GNSS satellites provided to the UE |

**Question 3**: Please provide your technical comments to the CR in R2-2303196

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| Answers to Question 3 | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | Yes | The CR implements the feature correctly |
| OPPO |  | Confused with the IE definition of ‘referenceAltitude’. In the CR, it is defined as the upmost layer of the grid relative to the reference altitude, which seems not aligns with the IE name. In our opinion, the IE ‘reference altitude’ is to define the altitude of the reference layer but not the altitude of the highest layer of the grid. |
| Vodafone | Yes | The actual height value is named ‘referenceAltitude’ as this height specifies the height value to which to other levels in the grid are based, or to which they are “referred”, and hence the name of the IE.  The description of the referenceAltitude can be improved as e.g. suggested above. |
| CATT | See the comments | Some comments on the ASN.1 aspect as follow.   1. In the definition of *GNSS-CommonAssistData*, *GNSS-GenericAssistData*, GNSS-*GenericAssistDataReq* and *GNSS-GenericAssistanceDataSupport*.   There is no comma with yellow highlight in current v17.4.0, so they should be added in this CR within revisions mode.  ,  [[  loS-NLoS-GridPoints-r18 LoS-NLoS-GridPoints-r18 OPTIONAL -- Need ON  ]]  ,  [[  loS-NLoS-GriddedIndications-r18 LoS-NLoS-GriddedIndications-r18  OPTIONAL -- Need ON  ]]  ,  [[ loS-NLoS-GridPointsReq-r18 LoS-NLoS-GridPointsReq-r18 OPTIONAL -- Cond LoS-GridReq  ]]  ,  [[  loS-NLoS-GridSupport-r18 LoS-NLoS-GridSupport-r18 OPTIONAL -- Cond LoS-NLoS-Grid-Sup  ]]  2. Miss comma in IE LoS-NLoS-GridPoints  stepSouth-r18 ENUMERATED {n05, n1, n2, n3, n4, n5, n10, n20,n50,n100},  stepEast-r18 ENUMERATED {n05, n1, n2, n3, n4, n5, n10, n20,n50,n100},  The comma with green highlight is missed.  3. wrong extension symbol in IE LoS-NLoS-GriddedIndications, e.g.  LoS-NLoS-GriddedIndications-r18 ::= SEQUENCE {  gridPointSetID-r18 INTEGER (0..16383),  expirationTime-r18 UTCTime OPTIONAL, -- Cond NotAlreadyProvided  gridList-r18 GridList-r18,  …  }  “…” should be “…”. |
| Intel | Yes with comments | 1 For the “proposed change affects” in the coverpage, Core Network should be ticked instead of Radio Access Network;  2 change on change should be removed, e.g.  loS-NLoS-GridPoints-r18 LoS-NLoS-GridPoints-r18 OPTIONAL -- Need ON  3 the term “los” used in field name should be consistence, e.g.  loS-NLoS-GriddedIndications-r18  los-InfoList-r18  4 r-18 should be added for “relativeLocationInfo” |
| Qualcomm |  | The *referencePointLatitude-r18*/*referencePointLongitude-r18* are provided with 15/16 bits resolution, which corresponds to a granularity of ~600 m. On the other hand, the grid steps can be down to 0.5 m. With up to 64 grid points, this can cover max 32 m (in 1-D) but relative to a reference point in steps of 600 m. This seems not fitting together.  What does *referenceAltitudeType-r18* = 'ground-level' mean? How does the UE know the 'ground level'? The grid should be a 3-D grid.  The whole *LoS-NLoS-GriddedIndications-r18* can have a single time stamp only (*expirationTime-r18*). However, each SV in the list changes from LOS to NLOS and vice-versa at different times. Therefore, each *LoS-InfoListElement-r18* should indicate for how long the SV is LOS or NLOS and should have its own 'expiration time', otherwise the *expirationTime-r18* will be extremely short, since there is always at least one SV among the up to 64 SVs which changes from e.g., LOS to NLOS in a short time.  Why can there be up to 128 *GridElement-r18*? Each grid can have 64 points only, so is this intended to provide only 2 altitude grids?  The number of grid points is only 64. With a 0.5m step size, this can cover an area of 4x4 m. This seems not sensible for broadcast. Or is the proposal that multiple tiles are being broadcast? If so, also multiple tiles of the grid points need to be broadcasted (and with proper resolution).  The IE *LoS-NLoS-GridSupport-r18* is nowhere defined. |
| Ericsson |  | In addition, there is a missing altitude definition based on the GridAltitude-r18 IE. This could be defined without a new IE and instead based on the GAD shape altitude definition (e.g. *EllipsoidPointWithAltitude*) in 23.032 [15]. It seems to be sufficient with a 1m resolution here.  LoS-NLoS-GridPoints-r18 ::= SEQUENCE {  gridPointsSetID-r18 ArrayOfGridPoints-r18,  referenceAltitudeType-r18 ENUMERATED {wgs84-ellipsoid, ground-level} OPTIONAL,  referenceAltitudeDirection-r18 ENUMERATED {height, depth} OPTIONAL,  referenceAltitude-r18 INTEGER (0..32767) OPTIONAL,  stepAltitude-r18 RelativeAltitudeElement-r18 OPTIONAL,  upperValidityStepAltitude-r18 RelativeAltitudeElement-r18 OPTIONAL,  lowerValidityStepAltitude-r18 RelativeAltitudeElement-r18 OPTIONAL,  ...  }  With suggested field descriptions:  ***referenceAltitudeDirection, referenceAltitude***  These fields specify the altitude of the upmost layer of the grid, where the altitude is in relation to the level defined by the *referenceAltitudeType.* The altitude encoding is defined in TS 23.032 [15].  However, I guess that in practical cases the value range of the altitude can be much smaller, but this is a value range that is established. Alternative is to use value ranges from the *RelativeLocation* IE  Regarding lat and long of the reference grid point. We agree with QC and one option is to follow the high accuracy shape instead  referencePointLatitude-r15 INTEGER(-2147483648..2147483647),  referencePointLongitude-r15 INTEGER(-2147483648..2147483647),  However, it could be reasonable to find an intermediate resolution between the crude one currently in the CR and the high accuracy one in order to save bits. |
| Lenovo |  | 1. Cover page:  * WI code “TEI-18” should be w/o dash; in the title a TEI tag name for the feature is missing; date is incomplete; setting of “Other specs affected” should be corrected to add TS 38.331 and TS 36.331.  1. ASN.1:  * IE LoS-NLoS-GridPoints-r18: Need codes are missing for the optional fields. * IE LoS-NLoS-GridPoints-r18: the IE GridAltitude-r18 is used but its definition is missing. * IE LoS-NLoS-GriddedIndications-r18: IE LoS-InfoListElement-r18 should be corrected to LoS-InfoElement-r18.   LoS-InfoList-r18 ::= SEQUENCE (SIZE(1..64)) OF LoS-InfoElement-r18  LoS-InfoListElement-r18 ::= SEQUENCE {  svID-r18 SV-ID,  los-r18 ENUMERATED{true, false, uncertain},  …  }   1. In 7.2: in posSIBType1-11 the part “IB” should be set in lowercase letter.  |  |  | | --- | --- | | *posSibType1-10* | *GNSS-Integrity-ServiceAlert* | | *posSIBType1-11* | *LoS-NLoS-GridPoints* | |
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**Summary 3**: The following questions were raised during discussion:

1. CATT: Several ASN 1 “,” need to be with revision marks or are missing
2. Intel: Cover page “CN” need to be ticked, Change on change need to be removed, “Los” should be written consistently, 4 “r-18 should be added for “relativeLocationInfo””
3. Lenovo: CoverPage related questions/corrections, ASN.1 related corrections, Editorial corrections to chapter 7.2
4. Qualcomm:
   1. *referencePointLatitude-r18*/*referencePointLongitude-r18 are provided with the 600 meter, but the steps can go down to 0.5, which would mean 32 meters with 64 points per layer.*
   2. *referenceAltitudeType-r18* = 'ground-level'. How the UE knows the ground level
   3. *LoS-NLoS-GriddedIndications-r18 can have a single step, but every* SV in the list changes from LOS to NLOS and vice-versa at different times. It is proposed to have a a time stamp/'expiration time' for every *LoS-InfoListElement-r18*
   4. *As per current specification, only 2 attitude layers are possible to provide. It should be clarified if this is an intention.*
   5. *The number of grid points is only 64. With a 0.5m step size, this can cover an area of 4x4 m. This seems not sensible for broadcast.*
   6. The IE *LoS-NLoS-GridSupport-r18* is nowhere defined

* OPPO: Definition/description of referenceAltitude might need to be improved

**Proposal 3**: It is proposed to have an email discussion till the next meeting addressing questions raised by Qualcomm and OPPO. The corrections associated with the proposed changes from CATT, Intel and Lenovo will be addressed in the same email discussion.

**Second Round:**

**Do you agree with Moderator proposal 3.**

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| Answers to Question 2 | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | Yes | Even though post meeting email discussions are discouraged, we think in this case it can make sense with a very focused email discussion over two weeks.  The email discussion could be focused on only the grid definition parameter representation to make it limited and to settle that part, such as:  1. The reference point latitude and longitude representation  a. some finer representation matching the smallest grid step length, currently 0.5m. For example, the GAD shape Point corresponds to 3m with 24 bits for lat and long respectively, so using 26 bits could be appropriate (Lat – one bit to represent the sign, and 25 bits for the value INTEGER (0..33554431), Long INTEGER (-33554432.. 33554431))  2. Supported grid step lengths in meters  a. current CR has 0.5m to 100m  b. additional/other values?  3. Number of possible vertical layers  a. current CR has 1-2 layers  b. additional layers?  4. Reference for the reference altitude  a. current CR describes hight over ground and over WGS84 ellipsoid  b. other scope  It seems like this would be a very focused activity where we might be able to converge. |
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**Summary 3 update after second round**: 1 company provided a comment on the potential scope of email discussion

**Proposal 3 (update after second round)**: Following comments based on R2-2303196 (LLP CR). It is proposed to have 2 weeks email discussion addressing questions raised by Qualcomm and OPPO and focusing on the grid representation questions as highlighted by E///:

1. The reference point latitude and longitude representation

2. Supported grid step lengths in meters

3. Number of possible vertical layers

4. Reference for the reference altitude

CR R2-2303200 [3] for 38.331

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| ***Reason for change:*** | The determination of the accuracy is one of the major tasks of GNSS receiver and the increased accuracy is very important especially in the multi-path environment like urban canyon for many use cases. In order to achieve it, the assistance information of Line of Sight (LOS) / Non Line of Sight (NLOS) of satellites of a particular satellite in a given location is required to assist GNSS receiver. |
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| ***Summary of change:*** | The support of assistance information about LOS/NLOS GNSS satellites, corresponding UE capability and the information to request LOS/NLOS GNSS satellites assistance data are introduced as two new posSIBs |
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| ***Consequences if not approved:*** | Broadcast of GNSS LoS/NLoS is not possible in NR |

**Question 4**: Please provide your technical comments to the CR in R2-2303200

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| Answers to Question 4 | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | Yes | The CR implements the feature correctly |
| CATT | Yes |  |
| Vodafone | Yes |  |
| Spirent | Yes |  |
| Intel | Yes |  |
| Lenovo |  | 1. Cover page:  * WI code “TEI-18” should be w/o dash; in the title a TEI tag name for the feature is missing; setting of “Other specs affected” should be corrected to add TS 37.355 and TS 36.331. * In the “Summary of change” the capability part should be removed:   The support of assistance information about LOS/NLOS GNSS satellites, ~~corresponding UE capability~~ and the information to request LOS/NLOS GNSS satellites assistance data are introduced as two new posSIBs   1. ASN.1:  * For the new values in posSibType-r16 the suffix “-v1800” should be corrected to “-v18xy”. * For the new values in posSIB-TypeAndInfo-r16 the part “IB” should be set in lowercase letter, the suffix “-v1800” should be corrected to “-v18xy”.   posSib6-6-v1700 SIBpos-r16,  posSIB1-11-v1800 SIBpos-r16,  posSIB2-26-v1800 SIBpos-r16   * For the new values in type2-r17 the suffix “-v18xy” should be added. |
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**Summary 4**: One company provided the following questions: CoverPage related questions/corrections, ASN.1 related corrections, Editorial corrections to chapter 7.2

**Proposal 4**: It is proposed to update R2-2303200 considering the proposed changes and will be presented during the next RAN2 meeting

**Second Round:**

**Do you agree with Moderator proposal 4:**

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| Answers to Question 2 | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | Yes |  |
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CR in R2-2303206 [4] proposes the following changes to TS 36.331

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| ***Reason for change:*** | The determination of the accuracy is one of the major tasks of GNSS receiver and the increased accuracy is very important especially in the multi-path environment like urban canyon for many use cases. In order to achieve it, the assistance information of Line of Sight (LOS) / Non Line of Sight (NLOS) of satellites of a particular satellite in a given location is required to assist GNSS receiver. |
|  |  |
| ***Summary of change:*** | The support of assistance information about LOS/NLOS GNSS satellites, corresponding UE capability and the information to request LOS/NLOS GNSS satellites assistance data are introduced as two new posSIBs |
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| ***Consequences if not approved:*** | Broadcast of GNSS LoS/NLoS is not possible in LTE |

**Question 5**: Please provide your technical comments to the CR in R2-2303206

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| Answers to Question 5 | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | Yes | The CR implements the feature correctly |
| CATT | Yes |  |
| Vodafone | Yes |  |
| Spirent | Yes |  |
| Intel | Yes with comments | Definition is missing for the fields, they are not linked with any IEs.  [[  posSibType1-11-v1800,  posSibType2-26-v1800  ]] |
| Lenovo |  | 1. Cover page:  * WI code “TEI-18” should be w/o dash; in the title a TEI tag name for the feature is missing; setting of “Other specs affected” should be corrected to add TS 37.355 and TS 38.331. * The “Summary of change” should simply say:   The support of assistance information about LOS/NLOS GNSS satellites is introduced as two new posSIBs.   1. ASN.1:  * In posSIB-TypeAndInfo-r15, i.e. the type “SystemInformationBlockPos-r15” should be added for the new values; in the value names “Type” should be removed; suffix “-v1800” should be corrected to “-v18xy”.   [[  posSib1-9-v1700 SystemInformationBlockPos-r15,  posSib1-10-v1700 SystemInformationBlockPos-r15  ]],  [[  posSib~~Type~~1-11-v18xy SystemInformationBlockPos-r15,  posSib~~Type~~2-26-v18xy SystemInformationBlockPos-r15  ]]   * In posSibType-r15 the suffix “-v1800” should be corrected to “-v18xy”.   posSibType1-9-v1700,  posSibType1-10-v1700,  posSibType1-11-v1800,  posSibType2-26-v1800 |
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**Summary 5**: 2 companies provided change proposals.

Intel: Cover page related, It seems that posSibType1-11-v1800 and posSibType2-26-v1800 are not linked to any IE

Lenovo: Cover page related. Change to the suffix.

**Proposal 5**: It is proposed to update R2-2303206 considering the proposed changes.

**Second Round:**

**Do you agree with Moderator proposal 5:**

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| Answers to Question 2 | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | Yes |  |
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# 4 Conclusion

7 companies participated in the email discussion and moderator would like to propose the following:

**Proposal 1**: As no other general questions (except of 1 which was clarified) were received, it is proposed to discuss all other detailed technical aspects within Stage 3 discussion.

**Proposal 2**: It is a moderator understanding that companies participated in the email discussion are fine to introduce LOS/NLOS feature to Rel.18 and therefore it is proposed to proceed with stage 3 details to support LOS/NLOS information based on R2-2303196, R2-2303200, R2-2303206

**Proposal 3**: Following comments based on R2-2303196 (LLP CR). It is proposed to have 2 weeks email discussion addressing questions raised by Qualcomm and OPPO and focusing on the grid representation questions as highlighted by E///:

1. The reference point latitude and longitude representation

2. Supported grid step lengths in meters

3. Number of possible vertical layers

4. Reference for the reference altitude

The corrections associated with the proposed changes from CATT, Intel and Lenovo will be addressed in the CR to the next meeting.

**Proposal 4:** It is proposed to update R2-2303200 considering the proposed changes and will be presented during the next RAN2 meeting

**Proposal 5:** It is proposed to update R2-2303206 considering the proposed changes and will be presented during the next RAN2 meeting