3GPP TSG RAN WG1 Meeting #108-e R1-2202601

e-Meeting, February 21st – March 3rd, 2022

Agenda Item: 8.4.4

Source: Moderator (OPPO)

Title: Summary#1 of discussion on maintenance related to signaling of polarization information

Document for: Discussion and Decision

# Introduction

This document summarizes the discussion for the following assignment

[108-e-R17-NR-NTN-04] Email discussion/approval on maintenance related to signaling of polarization information – Hao (OPPO)

* 1st check point: February 25
* Final check point: March 3

# Discussions

[CLOSE] issue 1: RAN1 agreements were not captured by RAN2 (proposed by DCM [1])

**Proposal 1:**

* *Send an LS to RAN2 in order to ask RAN2 to include polarization indication in NTN-specific SIB according to RAN1 agreements.*

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| --- |
| Agreement:  For explicit indication of polarization information for DL by the network, support indication in SIB   * FFS: Signaling details for indication in SIB   Agreement:   * Polarization information for UL may be indicated in SIB by the network * UE assumes a same polarization for UL and DL, when the UL polarization information is absent. * FFS: Signaling details for indication in SIB   Agreement:  When polarization signalling is present in SIB   * SIB indicates DL and/or UL polarization information using respective polarization type parameters to indicate: RHCP or LHCP or linear * FFS: whether polarization signalling is per SSB |

FL views: based on RAN2 running CR R2-220189, it seems that the agreements were captured in NTN-Config IE. Thus, no need to send LS.

First round discussion

|  |  |
| --- | --- |
| Company name | Company views |
| Nokia, Nokia Shanghai Bell | Agree that the R2-2201895 running CR for 38.331 captures the polarization indication in the *NTN-Config-r17* IE.  Hence we support not sending an LS on this aspect. |
| NTT DOCOMO | We understand the RAN2 situation now, then fine not to send LS on this aspect. |
| ZTE | According to the latest updates from RAN2, it’s fine not to send the LS. |
| LG electronics | We also fine not to send reply LS. |
| Lenovo | Agree with moderator. |
| Huawei, HiSilicon | Agree. |
| Panasonic | Agree |
| Lockheed Martin | Agree |
| Apple | Agree with FL |
| QC | Agree |
| CMCC | Agree with FL |
| Moderator | It seems all companies agree that the LS is not needed. |
| Ericsson | Agree with FL |

[ACTIVE] issue 2: UE behavior upon gNB polarization indication (proposed by Ericsson [2])

Proposal 1: RAN1 to discuss whether the polarization information related agreements have impact on RAN1 specification(s) and if so how to capture the agreements in the RAN1 specification(s).

Proposal 2: RAN1 to include the following polarization agreements in an updated overall RRC parameter list to be sent to RAN2 or send a separate LS to RAN2 on these agreements: (1) Support polarization signalling for target serving cell in handover command message, and (2) Support polarization signalling for non-serving cell in RRM measurement configuration.

Proposal 3: If a cell indicates an uplink polarization that is not supported by a UE, the UE shall not access the cell.

Proposal 4: Send an LS to RAN2 to specify UE behavior in case the UE does not support the polarization indicated by the network.

FL view: in RAN1#107-e meeting, we have had extensive discussions and the final conclusion says that no consensus on UE behavior. Thus, in this maintenance phase, FL does not see the need for reopening the debate.

**Conclusion:**

No further enhancement is considered for polarization signaling in NTN-NR R17.

No consensus on UE reporting polarization capability.

No consensus on UE behavior for selecting polarization mode for DL reception and UL transmission.

Regarding the proposal 2, FL agrees that RAN1 can send an updated RRC parameters to RAN2 if the 1) and 2) parameters are missing.

FL initial proposal for issue 2

Initial proposal 1: send an updated RRC parameters to RAN2, including parameters needed for capturing RAN1 agreements from RAN1#106bis-e meeting.

Agreement:

Support polarization signalling for target serving cell in handover command message.

Agreement:

Support polarization signalling for non-serving cell in RRM measurement configuration.

First round discussion

|  |  |
| --- | --- |
| Company name | Company views |
| Nokia, Nokia Shanghai Bell | In general, we should expect RAN2 to be aware of RAN1 agreements, and therefore we do not see a strong need for sending an LS to RAN2. |
| NTT DOCOMO | We are fine with the proposal. |
| ZTE | We are fine with the FL’s suggestion. |
| LG Electronics | Agree with Initial proposal. But, this aspect can be discussed under 8.4.2 (LS on NR NTN Neighbour Cell and Satellite Information) . |
| Lenovo | Fine to send LS to RAN2. |
| Huawei, HiSilicon | Agree |
| Panasonic | Agree to send LS. In addition, we are open to discuss UE behavior upon polarization indication. |
| Lockheed Martin | Agree |
| Apple | Fine with the proposal. |
| CMCC | Fine with the proposal. |
| Moderator | It seems majority companies think that RAN1 can send an LS to inform RAN2 about these two agreements.  Proposal for checkpoint is suggested in section 3. |
| Ericsson | An alternative to sending a dedicated LS to RAN2 to inform them about the two agreements is to include the corresponding (UE-specific) RRC parameters in the list of RRC parameters that will be sent to RAN2, and copy the RAN1 agreements in the comments column.  Regarding our Proposal 2 "If a cell indicates an uplink polarization that is not supported by a UE, the UE shall not access the cell", we do not think this is in contradiction with the conclusion from RAN1#107-e since it does not involve polarization signalling/reporting not selection of UE polarization mode. It is merely a sort of barring that would be specified in RAN2. If RAN1 agrees that this functionality is useful, we should send an LS to RAN2 to ask them to consider it. |

Second round discussion

In last meeting RAN1 made the following conclusion on the UE behavior upon gNB polarization indication:

No consensus on UE behavior for selecting polarization mode for DL reception and UL transmission.

In the second round discussion, companies are invited to provide thoughts on whether the UE not supporting the indicated polarization should be barred from accessing the network as suggested by the proposal 2 in [2]?

|  |  |
| --- | --- |
| Company name | Company views |
| Nokia, Nokia Shanghai Bell | According to our understanding of polarization, the discussion is a bit more complex than just applying barring. When we have a combination of circular polarized antenna and linear antenna at each end of the radio link, it is still possible to obtain a useful signal, but there will be a power loss (of 3 dB), which might be acceptable. Additionally, rotation of a device might change the polarization plane when we are talking about vertical/horizontal polarization. Hence, we would not be supportive of introducing such UE barring in case the UE is not able to support the polarization indication that is obtained from the gNB. |
| Huawei, HiSilicon | On this particular issue, our understanding is that it may not be possible to bar the UE if the UE found that there is a polarization mismatch since it is up to UE to stop attempting to access the network. Secondly, the UE may still get access to the gNB successfully even with the 3dB polarization loss. It is not clear the inter-cell interference will become an issue since it depends on how many UEs are in field and their polarization capability. Thirdly, coverage enhancement is one area that will be enhanced in Rel-18 where polarization loss is considered. The proposal barring scheme seems a bit contradictory to this.  In our view, if one would like to introduce a barring mechanism, it is preferred to have it under network controlled, e.g. a UE can report its polarization capability then it is up to the gNB to bar it from the cell or not. |
| LG Electronics | Our understaning is similar to Nokia and Huawei. Also, it is not clear the motivation of introduction of such barring mechanism. So, we do not support to introduce a barring mechanism. |
| Panasonic | We are supportive to introduce the baring. It is beneficial to support the baring to allow an operation with polarization reuse (e.g. 4-color scenario as in the current typical operation scenario) where the inter-cell interference is mitigated by using different polarization. The intention of the baring is not to avoid the 3dB polarization loss but to avoid the inter-cell interference in our understanding. |
| Baicells | On the issue “whether the UE not supporting the indicated polarization should be barred from accessing the network”, we would like to discuss UE’s DL detection and UL transmission separately.   1. UE DL detection is not necessary to be barred. Reason is: UE DL detection is not harmful to the network or to other UE. It is up to UE implementation. 2. UE UL transmission may be barred if UE UL polarization can not match with any of the Network UL polarization mode. The reason is to avoid unwanted interference and unnecessary UE efforts. It should be noted that the Network UL polarization may include one or multiple polarization modes. The Network can choose to relax the requirement on UL polarization matching, simply by adding non-perfect matching polarization modes into its polarization list in its SIB signaling, so that the UE may still get access to the gNB successfully even with the 3dB polarization loss. Hopefully this can resolve companies’ concerns on non-perfect matching issue.   We are open for further discussion on this issue. |
| Lenovo | We share similar view as Nokia, Huawei and LG that whether UE can access the network with mismatched polarization mode can be up to UE implementation. We don’t need to specifiy barring behaivous.  Regarding sepation of DL and UL due to inter-cell interference, our understanding is that interference to neighbor cell due to UE UL transmission is impacted by several factors, such as whether the UE is at cell edge, the beam UE selected, scheduling decision. We don’t think inter-cell interference due to mismatch polarization mode is too severe to bar the UE’s uplink transmission. |
| ZTE | We also share the views that no bar is needed in current stage and no need to mandate the UE’s hehavior since the polarization multiplexing is not supported in Rel-17.  In our view, the implementation of polarization is complicated and have additional requirements on UE’s implemeantion. For example, in current terminal, only linear polarization is supported and if the UE is forbidden to access the network with circular polarization (e.g., in the coverage of some beams in one cell), the service will be interrupted. With the mismatching between indicated polarization and UE’s action, it’s only lead to the poor link budget (due to the cross-polarization loss).  It’s recommended to consider this topic in future release along with the UE’s capability on polarization and target to improve UL performance. |

[ACTIVE] issue 3: polarization signaling enhancement

Proposed by ZTE [3]

***Observation 1****: Polarization indication to enable the deployment with either one or multiple beams per cell are needed.*

***Observation 2****: The polarization information for each beam can be derived by existing QCL association with SSB(s).*

***Proposal 1:*** *A polarization list should be included in the SIBx with the length determined by the number of supported SSB.*

Proposed by NEC [4]

***Proposal 4:*** *Support polarization signaling per beam.*

***Proposal 6:*** *Support UE polarization capability indication to gNB.*

Proposed by Huawei [5]

***Proposal 1:*** *For polarization signalling in SIB, support per SSB polarization indication and the same polarization can be assumed for other physical channels in each beam.*

***Proposal 2:*** *Both inter-UE and intra-UE polarization multiplexing based on gNB scheduling should be supported.*

***Proposal 3:*** *Support UE reporting polarization mode capability to gNB.*

FL view: beam-based polarization signaling and UE polarization capability reporting have been discussed extensively in RAN1#107-e meeting as well as previous meetings. There was not consensus on the enhancement and in RAN1#107-e the following conclusion was agreed. It clearly concluded that no further enhancement is considered for polarization signaling in NTN-NR R17. Thus, this debate should not be reopened in this meeting.

**Conclusion:**

No further enhancement is considered for polarization signaling in NTN-NR R17.

No consensus on UE reporting polarization capability.

No consensus on UE behavior for selecting polarization mode for DL reception and UL transmission.

First round discussion

|  |  |
| --- | --- |
| Company name | Company views |
| Nokia, Nokia Shanghai Bell | Agree with the FL view and proposal. |
| NTT DOCOMO | Agree with the FL view |
| ZTE | Regarding this topic, we understand that no consensus has been made in previous meeting. But based on the current conclusion, the typical deployment (e.g., one cell with multiple beams) is precluded in Rel-17, which is not expected for the commercialization.  If the situation can not be changed, we prefer to capture the following the conclusion in this meeting:  **Conclusion:**  The deployment scenario with multiple beams per cell is not supported in case of frequency reuse via different polarizations per beam(s) in Rel-17. |
| LG Electronics | Agree with FL. |
| Lenovo | Agree with FL’s view. |
| Huawei, HiSilicon | At least, per SSB polarization indication should be suppoted. According to 38.821, polarization reuse may be applied among beams to reduce the interference. With narrow SSB and polarization indication per SSB, UE can know the polarization of the serving beam. |
| Panasonic | We are open to discuss per SSB polarization indication to support a typical deployment with multiple beams per cell. |
| Lockheed Martin | Agree with FL. |
| Apple | Agree with FL’s view. |
| QC | Agree |
| CMCC | Reopen the discussion on per SSB polarization indication to support a typical deployment with multiple beams per cell is preferred. |
| Moderator | It seems majority companies support sticking to the previous RAN1 conclusion.  Regarding ZTE’s suggestion, although it is clear from the agreement that per-beam polarization indication is not supported, it is not harmful to draw a conclusion to make this clear. |

Second round discussion.

Please provide your views on the following conclusion.

Conclusion:

NTN-NR R17 does not support per-beam polarization signaling for any deployment scenarios.

|  |  |
| --- | --- |
| Company name | Company views |
| Ericsson | Agree |
| NTT DOCOMO | Agree |
| Apple | Agree |
| Nokia, Nokia Shanghai Bell | Agree |
| LG Electronics | Agree |
| Baicells | We incline to support per-beam polarization signaling. We will also be fine to agree with majority so that NTN-NR R17 progress can be speedup. |
| Lenovo | Our first preference is to support per-beam polarization signaling. However, based on last meeting agreement, we are fine with this conclusion. We also want to mention that there is no per beam polarization signaling for the scenario with multiple beams per cell, however, multiple beam per cell can still be supported without polarization multiplexing as in legacy release. |
| ZTE | We still prefer to support such configuration. But if the conclusion is needed to clarify the scope of Rel-17, the updated version below is preferred:  **Conclusion:**  The deployment scenario with different polarizations per beam(s) in one cell is not supported in Rel-17. |
| Huawei, HiSilicon | We don’t see the need to have such conclusion since it will be clear from RRC parameter list that the polarization will be per cell rather than per beam.  We also have some concerns on the proposed conclusion from ZTE. I would assume the deployment with multiple beams per cell using different polarizations is still possible but not optimized from polarization signaling point of view, right? |

[CLOSE] issue 4: beam measurement enhancement

Proposed by CMCC [6]

***Proposal 2:*** For the deployment scenario with multiple beam per cell and frequency reuse >1, at least support beam measurement on multiple RS associated with different beams within a same active BWP.

Proposed by NEC [4]

***Proposal 1:*** *To reduce measurement effort and retain some control of gNB over beam selection, it is proposed to support:*

* *Assign mutually exclusive CSI-RS resources to neighboring beams.*
* *Configure resource sets with possible combinations of candidate CSI-RS resources depending on the beam layout.*
* *Signaling from gNB indicates the candidate beams for measurement and beam switching.*
* *Assistance information from gNB includes any necessary information a UE would require to perform measurements on candidate beams.*
* *UE indicates selected beam for switching to the gNB based on measurement results from the candidate beams from the configured CSI-RS set(s).*

***Proposal 3:*** *Support the L1 filtered measurement report as a notification to gNB for BWP switching.*

FL Note: This topic is not in the maintenance scope according to chairman guidance for AI 8.4.4.

[CLOSE] issue 5: assistance information to support UE-based SMTC adjustment

Proposed by ZTE [3]

***Proposal 3:*** *The RTT difference between current and next satellites for a given cell, with regard to a given reference location, can be estimated and provided to UEs by the gNB.*

FL Note: This topic is not in the maintenance scope according to chairman guidance for AI 8.4.4.

[CLOSE] other aspects

The following proposals were suggested by Nokia [7]

**Proposal 1:** Update the RRC parameter table such that the following parameters are marked as both cell-specific and UE specific parameters: TACommon, TACommonDrift, TACommonDriftVariation, ServingSatelliteEphemerisStateVectorX, ServingSatelliteEphemerisStateVectorY, ServingSatelliteEphemerisStateVectorZ, ServingSatelliteEphemerisStateVectorVx, ServingSatelliteEphemerisStateVectorVy, ServingSatelliteEphemerisStateVectorVz, ServingSatelliteEphemerisSemiMajorAxis, ServingSatelliteEphemerisEccentricityE, ServingSatelliteEphemerisArgumentOfPeriapsis, ServingSatellite EphemerisLongitudeOfAscendingNode, ServingSatelliteEphemerisInclinationI, ServingSatelliteEphemerisMeanAnomalyM, ntnUlSyncValidityDuration, EpochTime.

**Proposal 2:** Change the RRC parameter name of ServingSatelliteEphemerisInclinationI to ServingSatelliteEphemerisInclination.

**Proposal 3:** Change the RRC parameter name of ServingSatelliteEphemerisMeanAnomalyM to ServingSatelliteEphemerisMeanAnomaly.

**Proposal 4:** Update the RRC parameter table, such that *CellSpecific\_Koffset* and *K\_mac* are marked as both cell-specific and UE specific parameters.

**Proposal 5:** RAN1 to update the descriptions and ranges for the above discussed NTN related RRC parameters in order to ensure clear and well-defined interpretations of these.

**Proposal 6:** Write an LS to RAN2 to inform of the suggested and required changes of RRC parameter properties and names.

FL Note: This topic is not in the maintenance scope according to chairman guidance for AI 8.4.4.

# Proposals for checkpoints

Checkpoint Feb. 25

Proposal #1: send an LS to RAN2 to inform the following agreements

Agreement:

Support polarization signalling for target serving cell in handover command message.

Agreement:

Support polarization signalling for non-serving cell in RRM measurement configuration.

Checkpoint Mar. 3

# References

|  |  |  |  |
| --- | --- | --- | --- |
| **[1]** | [**R1-2201479**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201479.zip) | Remaining issues on other aspects for NR NTN | NTT DOCOMO, INC. |
| **[2]** | [**R1-2201812**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201812.zip) | On other maintenance issues for NR NTN | Ericsson |
| **[3]** | [**R1-2202209**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202209.zip) | Remaining issues of additional enhancement for NR-NTN | ZTE |
| **[4]** | [**R1-2202364**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202364.zip) | Remaining issues for NR NTN | NEC |
| **[5]** | [**R1-2202424**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202424.zip) | Discussion on other design aspects for NTN | Huawei, HiSilicon |
| **[6]** | [**R1-2201855**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201855.zip) | Other Aspects for NTN | CMCC |
| **[7]** | [**R1-2201648**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201648.zip) | Maintenance aspects of RRC parameters for Rel-17 NR over NTN | Nokia, Nokia Shanghai Bell |