**3GPP TSG-RAN WG2 Meeting 110-e R2-2005905**

**Online, 1st – 12th Jun, 2020**

Agenda Item: 6.8.2.4

Source: Huawei, HiSilicon

Title: [AT110-e] [Offline-618][POS] MAC proposals (Huawei)

Document for: Discussion, Decision

# Introduction

In RAN2#110-e, the following two documents have been provided for the tdocs submitted under agenda item 6.8.2.4 that are considered should be discussed.

[1] [R2-2004636](file:///C:\Users\mtk16923\Documents\3GPP%20Meetings\202006%20-%20RAN2_110-e,%20Online\Extracts\R2-2004636%20MAC%20CE.docx), Discussion and corrections for MAC CE Design for Positioning, Ericsson discussion Rel-16

[2] [R2-2005211](file:///C:\Users\mtk16923\Documents\3GPP%20Meetings\202006%20-%20RAN2_110-e,%20Online\Extracts\R2-2005211_(38321%20PHR%20corrections).docx), Corrections to Power Headroom Reporting for SRS for positioning Qualcomm Incorporated discussion

The following way-forward with an email discussion was agreed during online

* [AT110-e][618][POS] MAC proposals (Huawei)

Scope: Discuss the proposals in the MAC papers (R2-2004636, R2-2005211) and incorporate agreeable conclusions into the MAC CR.

Intended outcome: Agreeable CR, update of R2-2005087 (in R2-2005905)

Deadline: Wednesday 2020-06-10 1000 UTC

In this email discussion, we progress based on the agreement online.

# Discussions

## 2.1 SP Positioning SRS activation/deactivation MAC CE

In [1], the relationship between SP positioning SRS (de-)activation MAC CE with supplementary uplink is discussed. In MAC CE design apart from normal UL, Supplementary Uplink has been specified to be supported for UL SRS configuration for positioning. The SRS configuration may be switched from SUL to NUL or vice-versa. This has not been as such taken into account or not discussed if it is supported for positioning context or not.

From MAC specification below is mentioned.

|  |
| --- |
| SUL operation The Supplementary UL (SUL) carrier can be configured as a complement to the normal UL (NUL) carrier. Switching between the NUL carrier and the SUL carrier means that the UL transmissions move from one carrier to the other carrier, which is done by:  - an indication in DCI;  - the Random Access procedure as specified in clause 5.1.1.  If the MAC entity receives a UL grant indicating an SUL switch while a Random Access procedure is ongoing, the MAC entity shall ignore the UL grant.  The Serving Cell configured with supplementaryUplink belongs to a single TAG. |

Thus in order to support this, gNB has to inform the LMF that a switching will occur in advance. This is not currently discussed in RAN2. Due to limited time left, it is good to omit SUL impact in Rel-16 for positioning.

Thus, [1] proposed ***not to support uplink carrier indication for supplementary/normal uplink in SP positioning SRS activation/deactivation MAC CE***. Companies are encouraged to provide opinions on the above proposal

Q1: Do companies agree that SP positioning SRS activation/deactivation MAC CE should not include the indication for uplink carrier?

|  |  |  |
| --- | --- | --- |
| Companies | Y/N | Comments |
| Ericsson | Y | RAN2 has not studies the full impact of SUL/NUL carrier switching. It is good to discuss this in Rel-17 and postpone the support of SUL configuration/indication via MAC CE in this release. |
| vivo | N | SUL is by default supported in MAC, we didn’t see any reason to remove those implementations. |
| Qualcomm | N | I understand RAN1 has agreed that carrier switching SRS for positioning is not supported in Release 16. However, I understand this agreement is related to switching for a carrier that does not have UL carrier at all; not between UL of different carriers. Given that this is already in the specification, it may be better to keep it. |
| Huawei, HiSilicon | N | The SUL/NUL switching is only applicable for PUSCH/PRACH. For PUSCH, SUL/NUL indicator in DCI content indicate the UL carrier to transmit PUSCH; for PRACH, the UE selects the UL carrier by comparing the RSRP with configured threshold.  For PosSRS, the above mentioned issue is not relevant. posSRS will be transmitted as long as it is configured/activated on a certain UL carrier. |
| CATT | N | No need to modify the current spec. |
| Nokia |  | If the use of SUL or NUL is transparent to LMF and is handled only at RAN level, then it is fine to support SUL in Rel-16. But it is not clear why gNB has to inform the LMF that a switching will occur in advance. If indeed such knowledge is required at the LMF then we have not discussed the impacts of supporting SUL very well in RAN2. If more discussion is required about such signalling from gNB to LMF then it is better to postpone support of SUL to Rel-17. |
| OPPO | N | We can follow the current spec to support SUL/NUL switching. |

Based on the above feedbacks, all the companies except one think that the SP positioning SRS activation/deactivation MAC CE should include UL carrier indication. Thus, we propose:

***Proposal1: SP positioning SRS activation/deactivation MAC CE includes UL carrier indication, i.e., no change to the current spec.***

Spatial relations are to provide alignment between UL and DL resource to facilitate UE UL transmission in desired direction especially for FR2 scenario. Spatial relations are instructions/recommendations that UE should follow but it is not a requirement that UE must follow.

Spatial relations are not needed for FR1 scenario. Alike in LTE, UE may transmit the UL SRS towards serving cell to minimize interference and the eighbour TRP performs the measurement (RTOA).

Similarly, in some confined/controlled area (Factory, indoor I-IOT), where TRPs are located close by, it could be enough to transmit the SRS without the need of spatial relations.

In RRC, spatial relations are OPTIONAL, the MAC CE design should also follow the same. It should be possible to activate/deactivate Semi-Persistent SRS configuration without having to include the spatial relations.

Thus, [1] proposed that *spatial relation is OPTIONAL in MAC CE design. Use one of the reserved bits to indicate presence/absence of spatial relations. By default, bit 0 may indicate the spatial relation is present, while when the bit is 1 the spatial relation is absent.*

Companies are encouraged to provide opinions on the above proposal

Q2: Do companies agree that SP positioning SRS activation/deactivation MAC CE should optionally contain indication of spatial relations?

|  |  |  |
| --- | --- | --- |
| Companies | Y/N | Comments |
| Ericsson | Y | Spatial Relation should be optional. Save MAC CE signalling by indicating presence/absence. |
| Vivo | Y |  |
| Qualcomm | Y | The argumentation sounds sensible. However, the same argumentation seems applicable to the MAC CE for “normal” SRS as well. So I wonder why it not optional for “normal” SRS? |
| Huawei, HiSilicon | N | The same issue also exists for R15 MAC CE and RAN2 choses not to resolve the issue. |
| CATT | Y |  |
| Nokia | Y | We are fine with making the configuration of spatial relation using MAC CE signalling optional like the configuration of spatial relations using RRC signalling. |
| OPPO | N | The current MAC CE with explicit spatial relation indication is fine. |

Out of 7 companies providing the feedback, 5 companies voted for yes while the other two voted for no.

Note that the R15 SP SRS activation/deactivation MAC CE always include the spatial relation indication. If the network does not configure the spatial relations, while in the MAC CE, the network includes the spatial relations, the UE just ignores the indications.

Thus, we propose the following:

***Proposal2: SP positioning SRS activation/deactivation MAC CE should optionally contain indication of spatial relations.***

DL PRS is also one of the candidates for the spatial relations for UL SRS. DL PRS is associated with UE specific TRP ID, PRS Resource Set and PRS Resource ID. For Positioning, the spatial relations are prepared based upon UE measurement report obtained in positioning method such as NR ECID. Given a UE specific TRP ID and DL PRS Resource set, UE knows and can judge which is the best neighbor beam to orient its UL SRS transmission. UE can identify the DL PRS resource received with strongest power or fastest arrival time from a given DL PRS Resource set.

If the DL PRS Resource ID is Optional then in scenarios where NW is not able to identify the best beam (example if UE’s orientation is changing rapidly), and it will allow to save one octet in MAC CE design by not including it and letting UE select the best beam.

Thus, [1] proposed that *DL PRS Resource ID is OPTIONAL in MAC CE design. Use one of the reserved bits to indicate presence/absence of DL PRS Resource ID. By default, bit 0 may indicate the DL PRS Resource ID is present, while when the bit is 1 the DL PRS Resource ID is absent.*

Companies are encouraged to provide opinions on the above proposal

Q3: Do companies agree that SP positioning SRS activation/deactivation MAC CE should optionally contain indication of DL PRS resource ID?

|  |  |  |
| --- | --- | --- |
| Companies | Y/N | Comments |
| Ericsson | Y | DL PRS Resource ID can be optional as UE can identify the resource ID based upon TRP ID and Resource Set. It will save MAC CE signalling. |
| vivo | Y |  |
| Qualcomm | N (for consistency) | Also the SSB Index is mandatory for a PCI. Why should the DL PRS Resource ID then changed to optional? If the argumentation is valid, it should apply to all RSs. |
| Huawei, HiSilicon | Y | We have agreed in RRC that DL PRS can be optional.  DL-PRS-Info-r16 ::= SEQUENCE {  trp-Id-r16 INTEGER (0..255),  dl-PRS-ResourceSetId-r16 INTEGER (0..7),  dl-PRS-ResourceId-r16 INTEGER (0..63) OPTIONAL -- Need R  }  If this field is not configured, there is no need to indicate the PRS resource id in the MAC CE. For us this is a new issue. |
| CATT | Y |  |
| Nokia | Y | Isn’t the DL PRS Resource ID included only if the spatial relation configuration is signalled in MAC CE? If this is the case, then it is fine to optionally include the DL PRS resource ID. |
| OPPO | N |  |

Out of the 7 companies providing the feedbacks, 5 companies voted for yes while 2 companies voted for no. Thus, we propose***Proposal3: SP positioning SRS activation/deactivation MAC CE should optionally contain indication of DL PRS resource ID***

## 2.2 PHR MAC CE and Positioning SRS

Power Headroom Reporting (PHR) is specified in TS 38.321, clause 5.4.6. Type 3 power headroom is related to SRS transmission per activated Serving Cell.

The PHR reporting procedure requires a PHR to be triggered when the pathloss on the current pathloss reference differs from the pathloss measured on the pathloss reference in use at the time of the previous PHR. Specifically, the TS 38.321, clause 5.4.6 text is as follows [1]:

|  |
| --- |
| A Power Headroom Report (PHR) shall be triggered if any of the following events occur:  - *phr-ProhibitTimer* expires or has expired and the path loss has changed more than *phr-Tx-PowerFactorChange* dB for at least one activated Serving Cell of any MAC entity which is used as a pathloss reference since the last transmission of a PHR in this MAC entity when the MAC entity has UL resources for new transmission;  NOTE 1: The path loss variation for one cell assessed above is between the pathloss measured at present time on the current pathloss reference and the pathloss measured at the transmission time of the last transmission of PHR on the pathloss reference in use at that time, irrespective of whether the pathloss reference has changed in between. |

Rel-16 Positioning introduced new pathloss-references from non-serving cells. The procedure as defined above implies that pathloss as measured using these new pathloss references could also cause PHR to be triggered. Further, as per NOTE 1 above, PHR may be triggered even due to change of pathloss as measured between pathloss-references from different cells (a serving cell and a nonserving cell). This leads to unnecessary triggering of PHR, because the pathlosses of serving and nonserving cells may be very different, and this doesn’t necessarily indicate a significant change in available transmit power at the UE.

Therefore, [2] proposes that ***the pathloss references configured by pathlossReferenceRS-Pos should be excluded from the triggering of PHR***. [2] also pointed out that this is in agreement with the RAN1#100bis-e:

Conclusion:

For release 16, type3 PHR based on SRS for positioning is not supported.

Companies are encouraged to provide opinions on the above proposal

Q4: Do companies agree that PHR should not be triggered when pathloss reference for positioning SRS has changed more than *phr-TxPowerFactorChange*?

|  |  |  |
| --- | --- | --- |
| Companies | Y/N | Comments |
| Ericsson | Y | We agree with the motivation |
| vivo | Y |  |
| Qualcomm | Y | It may create confusion otherwise. |
| Huawei, HiSilicon | Y | We agree that there is no need to trigger the PHR when the pathloss exceeds the configured threshold. Even if the PHR is triggered, the calculation of PH does not take into account posSRS. |
| CATT | Y |  |
| Nokia | Y | We have not discussed PHR reporting impacts for positioning. So, it is good to clarify the PHR reporting for positioning. If the decision is to not trigger PHR for pathloss reference defined for positioning SRS, we are fine with it. |
| OPPO | N | PHR is still needed for serving cell to know the power budget since pathloss reference for neighbour cell also occupy UE power. |

Out of the 7 companies providing the feedbacks, 6 companies voted for yes while 1 companies voted for no. Thus we propose

***Proposal4: PHR should not be triggered when pathloss reference for positioning SRS has changed more than phr-TxPowerFactorChange***

# Conclusion

In this email discussion, we progress based on the result of the online discussion during R2#110-e and propose the following:

***Proposal1: SP positioning SRS activation/deactivation MAC CE includes UL carrier indication, i.e., no change to the current spec.***

***Proposal2: SP positioning SRS activation/deactivation MAC CE should optionally contain indication of spatial relations.***

***Proposal3: SP positioning SRS activation/deactivation MAC CE should optionally contain indication of DL PRS resource ID***

***Proposal4: PHR should not be triggered when pathloss reference for positioning SRS has changed more than phr-TxPowerFactorChange***

# Text Proposal

============================FIRST CHANGE============================================

5.4.6 Power Headroom Reporting

The Power Headroom reporting procedure is used to provide the serving gNB with the following information:

- Type 1 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH transmission per activated Serving Cell;

- Type 2 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH and PUCCH transmission on SpCell of the other MAC entity (i.e. E-UTRA MAC entity in EN-DC, NE-DC, and NGEN-DC cases);

- Type 3 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for SRS transmission per activated Serving Cell.

RRC controls Power Headroom reporting by configuring the following parameters:

- *phr-PeriodicTimer*;

- *phr-ProhibitTimer*;

- *phr-Tx-PowerFactorChange*;

- *phr-Type2OtherCell*;

- *phr-ModeOtherCG*;

- *multiplePHR*.

A Power Headroom Report (PHR) shall be triggered if any of the following events occur:

- *phr-ProhibitTimer* expires or has expired and the path loss has changed more than *phr-Tx-PowerFactorChange* dB for at least one activated Serving Cell of any MAC entity which is used as a pathloss reference since the last transmission of a PHR in this MAC entity when the MAC entity has UL resources for new transmission;

NOTE 1: The path loss variation for one cell assessed above is between the pathloss measured at present time on the current pathloss reference and the pathloss measured at the transmission time of the last transmission of PHR on the pathloss reference in use at that time, irrespective of whether the pathloss reference has changed in between. The current pathloss reference for this purpose does not include any pathloss reference configured using *pathlossReferenceRS-Pos*.

- *phr-PeriodicTimer* expires;

- upon configuration or reconfiguration of the power headroom reporting functionality by upper layers, which is not used to disable the function;

- activation of an SCell of any MAC entity with configured uplink;

- addition of the PSCell (i.e. PSCell is newly added or changed);

- *phr-ProhibitTimer* expires or has expired, when the MAC entity has UL resources for new transmission, and the following is true for any of the activated Serving Cells of any MAC entity with configured uplink:

- there are UL resources allocated for transmission or there is a PUCCH transmission on this cell, and the required power backoff due to power management (as allowed by P-MPRc as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16]) for this cell has changed more than *phr-Tx-PowerFactorChange* dB since the last transmission of a PHR when the MAC entity had UL resources allocated for transmission or PUCCH transmission on this cell.

NOTE 2: The MAC entity should avoid triggering a PHR when the required power backoff due to power management decreases only temporarily (e.g. for up to a few tens of milliseconds) and it should avoid reflecting such temporary decrease in the values of PCMAX,f,c/PH when a PHR is triggered by other triggering conditions.

NOTE 3: If a HARQ process is configured with *cg-RetransmissionTimer* and if the PHR is already included in a MAC PDU for transmission by this HARQ process, but not yet transmitted by lower layers, it is up to UE implementation how to handle the PHR content.

If the MAC entity has UL resources allocated for a new transmission the MAC entity shall:

1> if it is the first UL resource allocated for a new transmission since the last MAC reset:

2> start *phr-PeriodicTimer*;

1> if the Power Headroom reporting procedure determines that at least one PHR has been triggered and not cancelled; and

1> if the allocated UL resources can accommodate the MAC CE for PHR which the MAC entity is configured to transmit, plus its subheader, as a result of LCP as defined in clause 5.4.3.1:

2> if *multiplePHR* with value *true* is configured:

3> for each activated Serving Cell with configured uplink associated with any MAC entity:

4> obtain the value of the Type 1 or Type 3 power headroom for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213 [6];

4> if this MAC entity has UL resources allocated for transmission on this Serving Cell; or

4> if the other MAC entity, if configured, has UL resources allocated for transmission on this Serving Cell and *phr-ModeOtherCG* is set to *real* by upper layers:

5> obtain the value for the corresponding PCMAX,f,c field from the physical layer.

3> if *phr-Type2OtherCell* with value *true* is configured:

4> if the other MAC entity is E-UTRA MAC entity:

5> obtain the value of the Type 2 power headroom for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity);

5> if *phr-ModeOtherCG* is set to *real* by upper layers:

6> obtain the value for the corresponding PCMAX,f,c field for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity) from the physical layer.

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Multiple Entry PHR MAC CE as defined in clause 6.1.3.9 based on the values reported by the physical layer.

2> else (i.e. Single Entry PHR format is used):

3> obtain the value of the Type 1 power headroom from the physical layer for the corresponding uplink carrier of the PCell;

3> obtain the value for the corresponding PCMAX,f,c field from the physical layer;

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Single Entry PHR MAC CE as defined in clause 6.1.3.8 based on the values reported by the physical layer.

2> start or restart *phr-PeriodicTimer*;

2> start or restart *phr-ProhibitTimer*;

2> cancel all triggered PHR(s).

==========================SECOND CHANGE============================================

6.1.3.36 SP Positioning SRS Activation/Deactivation MAC CE

The SP Positioning SRS Activation/Deactivation MAC CE is identified by a MAC subheader with LCID and eLCID as specified in Table 6.2.1-1. It has a variable size with following fields:

- A/D: This field indicates whether to activate or deactivate indicated SP Positioning SRS resource set. The field is set to 1 to indicate activation, otherwise it indicates deactivation;

- Positioning SRS Resource Set's Cell ID: This field indicates the identity of the Serving Cell, which contains activated/deactivated SP Positioning SRS Resource Set. If the C field is set to 0, this field also indicates the identity of the Serving Cell which contains all resources indicated by the Spatial Relation for Resource IDi fields, if present. The length of the field is 5 bits;

- Positioning SRS Resource Set's BWP ID: This field indicates a UL BWP as the codepoint of the DCI *bandwidth part indicator* field as specified in TS 38.212 [9], which contains activated/deactivated SP Positioning SRS Resource Set. If the C field is set to 0, this field also indicates the identity of the BWP which contains all resources indicated by the Spatial Relation for Resource IDi fields, if present. The length of the field is 2 bits;

- C: This field indicates whether the octets containing Resource Serving Cell ID field(s) and Resource BWP ID field(s) withn the field Spatial Relation for Resource ID i are present, except for Spatial Relation Resource IDi with DL-PRS or SSB. When A/D is set to 1, if this field is set to 1, the octets containing Resource Serving Cell ID field(s) and Resource BWP ID field(s) in the field Spatial Relation for Resource IDi are present, otherwise if this field is set to 0, they are not present. When A/D is set to 0, this field is always set to 0 that they are not present;

- SUL: This field indicates whether the MAC CE applies to the NUL carrier or SUL carrier configuration. This field is set to 1 to indicate that it applies to the SUL carrier configuration, and it is set to 0 to indicate that it applies to the NUL carrier configuration;

- Positoining SRS Resource Set ID: This field indicates the SP Positioning SRS Resource Set identified by *SRS-PosResourceSetId* as specified in TS 38.331 [5], which is to be activated or deactivated. The length of the field is 4 bits;

- Spatial Relation for Resource IDi: The field Spatial Relation for Resource IDi is only present if MAC CE is used for activation, i.e. the A/D field is set to 1. M is the total number of Positioning SRS resource(s) configured under the SP Positioning SRS resource set indicated by the field Positioning SRS Resource Set ID. There are 4 types of Spatial Relation for Resource IDi, which is indicated by the F (F0 and F1) field within. The fields within Spatial Relation for Resource IDi are shown in Figures 6.1.3.36-2 to 6.1.3.36-5 for the 4 types of Spatial Relations for Resource IDi;

- S: This field indicates whether the fields Spatial Relation for Resource IDi for the positioning SRS resource i within the positioning SRS resource set are present. If the field is set to 1, the fields Spatial Relation for Resource IDi are present; otherwise, they are absent;

- R: Reserved bit, set to 0.

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**Figure 6.1.3.36-1: SP Positioning SRS Activation/Deactivation MAC CE**

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**Figure 6.1.3.36-2: Spatial Relation for Resource IDi with NZP CSI-RS**

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**Figure 6.1.3.36-3: Spatial Relation for Resource IDi with SSB**

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**Figure 6.1.3.36-4: Spatial Relation for Resource IDi with SRS**

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**Figure 6.1.3.36-5: Spatial Relation for Resource IDi with DL-PRS**

The field Spatial Relation for Resource IDi consists of the following fields:

- F0: This field indicates the type of a resource used as a spatial relation for the ith Positioning SRS resource within the Positioning SRS Resource Set indicated with the field Positioning SRS Resource Set ID. The field is set to 00 to indicate NZP CSI-RS resource index is used; it is set to 01 to indicate SSB index is used; it is set to 10 to indicate SRS resource index is used; it is set to 11 to indicate DL-PRS index is used. The length of the field is 2 bits;

- F1: This field indicates the type of SRS resource used as spatial relation for the ith Positioning SRS resource within the SP Positioning SRS Resource Set indicated with the field Positioning SRS Resource Set ID when F0 is set to 10. The field is set to 0 to indicate SRS resource index *SRS-ResourceId* as defined in TS 38.331 [5] is used; the field is set to 1 to indicate Positioning SRS resource index *SRS-PosResourceId* as defined in TS 38.331 [5] is used;

- NZP CSI-RS Resource ID: This field contains an index of *NZP-CSI-RS-ResourceID*, as specified in TS 38.331 [5], indicating the NZP CSI-RS resource, which is used to derive the spatial relation for the positioning SRS. The length of the field is 8 bits;

- SSB index: This field contains an index of SSB *SSB-Index* as specified in TS 38.331 [5] and/or TS 37.355 [23]. The length of the field is 6 bits;

- PCI: This field contains physical cell identity *PhysCellId* as specified in TS 38.331 [5] and/or TS 37.355 [23]. The length of the field is 10 bits;

- SRS resource ID: When F1 is set to 0, the field indicates an index for SRS resource *SRS-ResourceId* as defined in TS 38.331 [5]; When F1 is set to 1, the field indicates an index for Positioning SRS resource *SRS-PosResourceId* as defined in TS 38.331 [5]. The length of the field is 5 bits;

- DL-PRS Resource Set ID: This field contains an index for DL-PRS Resource Set *nr-DL-PRS-ResourceSetId* as defined in TS 37.355 [23]. The length of the field is 3 bits;

- DL-PRS Resource ID: This field contains an index for DL-PRS resource *nr-DL-PRS-ResourceId* as defined in TS 37.355 [23]. The length of the field is 6 bits;

- DL-PRS ID: This field contains an identity for DL-PRS resource *dl-PRS-ID* as defined in TS 37.355 [23]. The length of the field is 8 bits;

- P: This field indicates whether the field DL-PRS ID is present within the Spatial Relation for Resource IDi with DL-PRS. If the field is set to 1, the field DL-PRS ID is present; otherwise, the field is absent;

- Resource Serving Cell IDi: This field indicates the identity of the Serving Cell on which the resource used for spatial relationship derivation for the ith Positioning SRS resource is located. The length of the field is 5 bits;

- Resource BWP IDi: This field indicates a UL BWP as the codepoint of the DCI *bandwidth part indicator* field as specified in TS 38.212 [9], on which the resource used for spatial relationship derivation for the ith Positioning SRS resource is located. The length of the field is 2 bits.

=============================END OF CHANGE=========================================