3GPP TSG-RAN WG1 Meeting #100-e R1-200NNNN

e-Meeting, May 25th –June 5th, 2020

Agenda Item: 7.2.8.2

Source: Moderator (Ericsson)

Title: Output of email discussion [101-e-NR-Pos-02] on DL PRS and UL SRS for NR positioning in rel16 maintenance

Document for: Discussion

# Introduction

This document is a summary of the email discussion [101-e-NR-Pos-02] on DL PRS and UL SRS for NR positioning in rel16 maintenance. The topics were decided as stated in the chairman’s notes:

[101-e-NR-Pos-02] Email discussion/approval on DL and UL PRS for NR positioning focusing on the following until 5/29; if necessary, endorse associated TPs by 6/4 – Florent (Ericsson)

* From summary on DL PRS (R1-2004726)
  + TPs with corrections to the TS 38.211 (4-1, 7-1, 8-2, 10-1, 10-2) and TS 38.214 (4-3, 7-2, 10-3), that are editorial in nature. The aspects 4-3 and 10-3 address the same section and can be merged in one TP.
  + DL PRS processing order (3-6, 9-4)
* From summary on UL PRS (R1-2004718):
  + Parameter level of a reference signal of spatialRelationInfo (Issue 1)
  + Aperiodic SRS for positioning in release 16 (Issue 2, 6)
  + Spatial relation of SRS positioning (Issue 4)
  + SRS collisions (Issues 5a, 5b)
  + TPs with corrections to 38.211 (Issue 8), 38.213 (Issue 9), 38.214 (Issue 7)
  + Simultaneous transmission of SRS-mimo and SRS-pos in CA (Issue 15)

The discussion is organized between DL issues, UL issues, corrections regarding the DL PRS and corrections regarding the UL SRS.

# DL PRS maintenance issues

## DL PRS processing order

### Proposals

#### Aspect 9-4. DL PRS processing order

DL-PRS Resources in the assistance data are sorted in a decreasing order of measurement priority. Specifically, according to the current RAN2 structure of the assistance data, the following priority is assumed:

* the 4 frequency layers are sorted according to priority,
* the 64 TRPs per frequency layer are sorted according to priority,
* the 2 sets per TRP of the frequency layer are sorted according to priority,
* the 64 resources of the set per TRP per frequency layer are sorted according to priority.

Feature lead response:

* RAN1 needs to make some agreement on raised aspect
* The discussion on similar topic is in the following aspects:
  + Aspect 3-5. DL PRS processing configuration
  + Aspect 8-1. It is proposed for the case that measurement gap is not configured and the configured PRS resources exceed the UE’s DL PRS processing capability, which PRS resources to be measured is up to UE implementation.

The initial proposal from [21] is

1. Proposal 4. When a UE is configured in the assistance data of a positioning method with a number of PRS resources beyond its capability (FG 13-2,13-3,13-4 for AoD, TDOA, MRTT respectively), the UE assumes the DL-PRS Resources in the assistance data are sorted in a decreasing order of measurement priority. Specifically, according to the current RAN2 structure of the assistance data, the following priority is assumed:
   1. the 4 frequency layers are sorted according to priority,
   2. the 64 TRPs per frequency layer are sorted according to priority,
   3. the 2 sets per TRP of the frequency layer are sorted according to priority,
   4. the 64 resources of the set per TRP per frequency layer are sorted according to priority.

#### Aspect 3-6. TP on DL PRS configuration priority

Discuss priority for DL PRS configuration and provides related TP to clause 5.1.6.5 of TS 38.214.

Feature lead response:

* Further discussion is needed on DL PRS processing order and if it is agreed on relevant TP.

The initial proposal from [15] is as follow (FL note: slight rewording to allow identifying the TP in the email discussion)

1. Endorse TP#1 to clause 5.1.6.5 of TS 38.214.

TP 1 on PRS configuration priority

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| --- |
| ===================== Unchanged parts are omitted ======================  If UE reports DL PRS resource capability for a positioning method in higher layer parameters [XX], and if UE is provided by the higher layers to receive PRS, UE is only expected to measure the DL PRS resources selected according to the following steps:  *-* Step.1 Select the first [X1] positioning frequency layers that does not exceed the higher layer parameter [YY1];  *-* Step.2 Select the first [X6] positioning nodes within all [X1] positioning frequency layers that does not exceed the higher layer parameter [YY6];  *-* Step.3 Select the first [X3] DL PRS resource sets within each positioning node on each positioning frequency layer from the X6 positioning nodes that does not exceed the higher layer parameter [YY3];  *-* Step.4 Select the first [X4] DL PRS resources within each DL PRS resource sets from the [X3] DL PRS resource sets that does not exceed the higher layer parameter [YY4];  *-* Step.5 Select the first [X7] DL PRS resources in the order of positioning node, DL PRS resource set, and DL PRS resource within a positioning frequency layer so that they do not exceed the higher layer parameter [YY7];  *-* Step.6 Select the first [X5] DL PRS resources in the order of positioning frequency layer, positioning node, DL PRS resource set, and DL PRS resource across all positioning frequency layers so that they do not exceed the higher layer parameter [YY5].  ===================== Unchanged parts are omitted ====================== |

### Feature lead summary and proposals:

Both proposal 1 and 2 provide a similar approach on how to handle prioritizing the PRS when the configuration exceeds the UE capability. If proposal 1 is agreeable, then the TP from proposal 2 can be discussed to capture the agreement in RAN1 specifications

Feature lead proposal#1: discuss proposal 1 during the first week (i.e. until 5/29) of the meeting and, if agreed, proceed to discuss the TP impact based on the TP in proposal 2 in the second week (i.e. from 6/1 to 6/5).

### Companies comments

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| Company | Comment |
| Huawei/HiSilicon | We just want to make sure that the consequence prioritization in section 2.1.1.1 is that UE will only process the prioritized PRS within its capability? If so, we support proposal 1, and TP in proposal 2. |
| ZTE | We think a simpler way is that UE is not allowed to be configured PRS beyond its capability. We will not have priorization problem then. |
| CATT | Support proposal 1 and proposal 2. |
| OPPO | Share similar view as ZTE. Why will LMF configure PRS beyond UE capability? If the case happens, leave it up to UE implementation. |
| Vivo | First of all, we don’t know why and how often this ‘over’ capability assistance data situation will happen. Given all the UE DL PRS processing capabilities reporting and even agreements of alignment/assumption between LMF and UE on DL PRS processing/buffering types were agreed, we don’t think this ‘over’ capability configuration is typical at least.  Recall that during the whole discussion of Rel-16 positioning SI/WI, UE was given the flexibility to choose, for example, a different reference for TDOA measurement. This could be due to better quality of that reference PRS resource. However, with proposal 1 here, such flexibility for a UE to choose may be limited in case a PRS with good quality is not in the priority list. Furthermore, with the very strict priority order in proposal 1: layer -> TRP -> set -> recourse, it is likely that a PRS resource with very good quality may have a lower priority than a PRS resource with rather bad quality but from a different layer/TRP. Lastly, following a priority order indicated by the assistance data may restrict UE implementation in the sense that a UE will have to complete processing/measuring all PRS resources on a TRP/layer before it can move to the next one. Considering the number of measurement report is much less than the number of processed PRS resource, such UE restriction may not make sense.  In general, we don’t see much value of this proposal and cannot accept it. |
| Nokia/NSB | We don’t see the need for the proposal. It can be left to implementation in our view. How would LMF know what order to set the priority? If the LMF already had that knowledge then why configure the UE with a larger set than the capability? |
| Huawei/HiSilicon2 | To all companies that think it can be avoided by configuration, we do not think it is true. There are also broadcast assistance data whose content is distributed prior to any capability exchange. Considering we do not have a basic FG for each of the positioning method, it is unlikely that broadcast AD will satisfy all UE capabilities! Over-capability AD is there even in LTE, where the priority has been captured for OTDOA.  In reply to vivo:  “However, with proposal 1 here, such flexibility for a UE to choose may be limited in case a PRS with good quality is not in the priority list.” 🡪 You assume that configuration can exceed UE capability by this sentence, correct? If there is such a flexibility, why should we define X1-X7 as capability (X2 excluded) in the first place?  “Furthermore, with the very strict priority order in proposal 1: layer -> TRP -> set -> recourse, it is likely that a PRS resource with very good quality may have a lower priority than a PRS resource with rather bad quality but from a different layer/TRP.” 🡪 I think that would be a bad assistance data provision. The point is that you are requesting UE to perform measurement exceeding its reported capability, which can happen for some advanced UEs, but it should not be universal.  “Lastly, following a priority order indicated by the assistance data may restrict UE implementation in the sense that a UE will have to complete processing/measuring all PRS resources on a TRP/layer before it can move to the next one.” 🡪 It is common assumption in RAN4 that positioning frequency layer processing is TDMed; however I fail to understand how the proposals imply that UE will have to complete processing all on a TRP/layer before the next one. UE has the freedom to jump around now and then, but the it should ensure that the PRS resources that UE needs to measurement is measured in the RAN4 defined latency requirement. |
| Qualcomm | Assistance data may not be tailored to a specific UE. Check for example the broadcast assistance data. Prioritization existed even in LTE TDOA, we don’t understand why companies are negative now. Especially for broadcast of assistance data, what the companies above are saying is that the LMF would not know which PRS resources each UE is even trying to process?  If the prioritization of the “layers” first is a problem, we could do what LTE TDOA is doing: “for each layer, the TRPs are ordered in priority”. So now, we can at least say: “for each method and for each layer, the TRPs are ordered first -> sets -> PRS resources ”. |
| Samsung | Agree with ZTE. Do not see the need for this proposal. |
| LG | As we mentioned in our contribution, our first preference is to leave it up to UE implementations. If it seems not reasonable, we would like to suggest that at least PRS resources and a TRP that are configured for reference timing should be considered as high priority. We have a modified proposal as follows:  Proposal 4. When a UE is configured in the assistance data of a positioning method with a number of PRS resources beyond its capability (FG 13-2,13-3,13-4 for AoD, TDOA, MRTT respectively), the UE assumes the DL-PRS Resources in the assistance data are sorted in a decreasing order of measurement priority. Specifically, according to the current RAN2 structure of the assistance data, the following priority is assumed:   * 1. the 4 frequency layers are sorted according to priority,   2. the 64 TRPs per frequency layer are sorted according to priority,   3. the 2 sets per TRP of the frequency layer are sorted according to priority,   4. the 64 resources of the set per TRP per frequency layer are sorted according to priority. * **For each frequency layer, the configured TRP and/or PRS as a reference (timing) configuration have the highest priority** |
| Intel | We do see the value in this proposal. LMF may be aware about network layout and may recommend processing of the first tier of stations then the second and so on. The recommendation may be cell specific. We are not sure whether frequency layers should be prioritized by LMF. In our view, frequency layers can be selected by UE depending on carrier, bandwidth, etc.  Therefore, we think that at least DL PRS Resources Sets and DL PRS Resources can be configured in recommended processing order. |
| Ericsson | Our preference is to leave it to implementation. Even for the case of broadcast AD, the UE can can decide how to choose the parts of the assistance data that fits its capability in case the AD is too large to be handled. Having a prioritization scheme presumes the network knows or at least can guess the received PRS quality. As Vivo mentioned, this is not generally the case and this is why we have flexibility in selecting references for measurements. |
| Sony | Same view as ZTE (UE shall not be allowed to have PRS configuration beyond its capability). |

### Conclusions

Intermediate summary:

The status is the following:

* In support of the proposals 1 and 2: Huawei/HiSilicon, Qualcomm
* Not in support of the proposals 1 and 2: ZTE, Oppo, Vivo, Nokia/NSB, Samsung, LG, Intel, Ericsson

Based on the majority, we propose the following offline consensus:

**Proposal for offline consensus 1: Conclusion: the DL PRS processing order prioritization in assistance data is not specified.**

Companies are encouraged to comment on the proposal for offline consensus:

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| --- | --- |
| Company | Comment |
| Sony | Support offline consensus 1. |
| Qualcomm | This feature existed in LTE already and it is essential for broadcast of Assistance data. We cannot agree on the above proposal. At least a minimum understanding of prioritization is needed, as it was done in LTE.  Therefore, we have to object in making the above conclusion. If RAN1 delegates do not see the need, we are OK to not conclude anything and try to send an LS to RAN2 to discuss it further. |
| Huawei/HiSilicon | I think LGE and Intel are OK with the proposal and recommend special handle of positioning frequency layers, which is fine for us.  What confuses us is that a PRS processing priority that has been adopted in LTE since Rel-9 is considered as non-acceptable in NR. Please see the following description in LPP:  The IE *OTDOA-NeighbourCellInfoList* is used by the location server to provide neighbour cell information for OTDOA assistance data. The set of cells in the *OTDOA-NeighbourCellInfoList* is grouped per frequency layer and in the decreasing order of priority for measurement to be performed by the target device, with the first cell in the list being the highest priority for measurement and with the same *earfcn* not appearing in more than one instance of *OTDOA‑NeighbourFreqInfo*. The prioritization of the cells in the list is left to server implementation. The target device should provide the available measurements in the same order as provided by the server.  In our understanding, LPP assistance data is called assistance data instead of configuration is because what is included is for the purpose of assistance, rather than to force UE to measure all of them.  In means that PRS information beyond UE capability leaves room for UE optimization in its best effort, while the measurement of those prioritized PRS within UE capability guarantees minimum performance requirement.  Always forcing LMF to provide PRS within UE capability will not allow further optimization from UE side, while completely leaving up to UE implementation in case of over-capacity assistance data will leave performance unspecified.  LMF is not gNB.  Broadcast assistance data is also very important.  We suggest to have the following proposal:  When a UE is configured in the assistance data of a positioning method with a number of PRS resources beyond its capability (FG 13-2,13-3,13-4 for AoD, TDOA, MRTT respectively), the UE assumes the DL-PRS Resources in the assistance data are sorted in a decreasing order of measurement priority. Specifically, according to the current RAN2 structure of the assistance data, the following priority is assumed:   * 1. the 4 frequency layers are sorted according to priority,   2. the 64 TRPs per frequency layer are sorted according to priority,   3. the 2 sets per TRP of the frequency layer are sorted according to priority,   4. the 64 resources of the set per TRP per frequency layer are sorted according to priority. * **LMF ensures the reference has the highest priority according to the rule.** |

## Processing of PRS without measurement gaps

### Aspect 8-1. DL PRS processing capability for the case w/o MG configured

It is proposed to not support DL PRS processing capability for the case without measurement gap. In case that measurement gap is not configured and the configured PRS resources exceed the UE’s DL PRS processing capability, which PRS resources to be measured is up to UE implementation.

Feature lead response:

* Aspect require RAN1 discussion and conclusion
* TBD whether it is to be discussed in DL PRS AI or under UE feature list

The initial proposal in [20] is as follow

1. Not support to define DL PRS processing capability especially for the case without measurement gap
   1. In case that measurement gap is not configured and the configured PRS resources exceed the UE’s DL PRS processing capability, which PRS resources to be measured is up to UE implementation.

### Companies comments

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| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | If we go with this proposal, we should send an LS to RAN4 not to define requirements for PRS measurement without gap. |
| ZTE | We are not clear how to define a new processing capability without MG since the scheduling of other signals/channels dynamically changed as some other companies pointed out. In some slots, there may not be other signals scheduled, the situation is similar as that with MG, then the new capability seems not used in this case. In some other slots, most of UE CPU may be occupied by some other signals, UE may not be able to process PRS, even the new capability without MG is defined. Maybe proponents can clarify how to handle these issues. |
| CATT | Support proposal 3. It can be treated up to UE implementation. |
| OPPO | Share the same view as Huawei |
| vivo | We support proposal 3.  Our understanding is that whether to configure measurement gap for a UE is determined by the serving gNB. Even if this UE processing capability without gap is provided to the LMF, the LMF cannot determine the corresponding assistant data as whether a UE is configured with a measurement gap is unknown to the LMF. So we support not to define a UE capability for the case without measurement gap.  Note that a related issue is also under [101-e-NR-Pos-01] email discussion. |
| Feature Lead | Discussion is also happening under [101-e-NR-Pos-01] so the discussion is redirected there. This section of the discussion is hereby closed. |

### Conclusions

The capability discussion under [101-e-NR-Pos-01] will cover this issue.

# UL SRS maintenance issues

## Parameter level of a reference signal of spatialRelationInfo

### proposals

The following proposals are made in [1] regarding the reference for the DL PRS in *spatialRelationInfo*

1. Change ’DL-PRS-ResourceId’ to ’dl-PRS-r16’.
2. Adopt the following text proposal into TS 38.214 for a reference ’dl-PRS-r16’.

TP 2

|  |
| --- |
| *TS 38.214-g10*  *6.2.1 UE sounding procedure*  < Unchanged parts are omitted >  - if the UE is configured with the higher layer parameter *spatialRelationInfo* containing the ID of a reference'ssb-Index', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* contains the ID of a reference 'csi-RS-Index', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, if the higher layer parameter *spatialRelationInfo* containing the ID of a reference 'srs', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS. When the SRS is configured by the higher layer parameter *srs-PosResource-r16* ~~[SRS-for-positioning]~~ and if the higher layer parameter *spatialRelationInfo* contains the ID of a reference ’*dl-PRS-r16~~DL-PRS-ResourceId~~*’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference DL PRS.  < Unchanged parts are omitted > |

### Companies comments

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| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | We do not see a strong reason to change '*DL-PRS-ResourceId*' to ‘dl-PRS-r16’; rather, we think it should be changed to '*dl-PRS-ResourceId-r16*' (as mentioned in TP 21 in Section 5.3.1.2). Note that only ‘ssb-index’ and ‘csi-RS-Index’ are used in Rel-15 to refer to the spatialRelationInfo in38.214. We prefer to use a similar approach and only mention the index of the spatialRelationInfo RS in 38.214. Also, if DL PRS is used as a spatialRelationInfo RS, for a given SRS resource, there is only ONE ‘dl-PRS-16’ configured which includes only ONE ‘dl-PRS-ResourceId-r16’. Therefore, there is a one to one mapping between ‘dl-PRS-16’ and ‘dl-PRS-ResourceId-r16’ within the SRS resource configuration and no confusion occurs if ‘dl-PRS-ResourceId-r16’ is kept in this part of the specification.  Also, this TP (TP2) concerns a part of the text in Clause 6.2.1 of 38.214 that TP 21 in Section 5.3.1.2 has covered. Multiple other changes in this part of the text are necessary that are not covered in TP2. |
| ZTE | Agree with Huawei. |
| CATT | Support proposal 4 and proposal 5. The parameter level of a reference ’DL-PRS-ResourceId’ is not equal to the level of 'ssb-Index', 'csi-RS-Index' and 'srs', it is reasonable to change ’DL-PRS-ResourceId’ to ’dl-PRS-r16’ in this section. |
| OPPO | DL-PRS-QCL-Info-r16 ::= CHOICE {  ssb-r16 SEQUENCE {  pci-r16 NR-PhysCellId-r16,  ssb-Index-r16 INTEGER (0..63),  rs-Type-r16 ENUMERATED {typeC, typeD, typeC-plus-typeD}  },  dl-PRS-r16 SEQUENCE {  qcl-dl-PRS-ResourceId-r16 NR-DL-PRS-ResourceId-r16,  qcl-dl-PRS-ResourceSetId-r16 NR-DL-PRS-ResourceSetId-r16  }  }  Seems *SSB-Index-r16* and *qcl-dl-PRS-ResourceId-r16* are at the same level. |
| vivo | Support proposal 4 and proposal 5.  Response to OPPO on their quoted specification, this is spatial information for SRS for positioning, not PRS. Let’s quote the relevant TS 38.331below.  *6.3.2 Radio resource control information elements*  SRS-SpatialRelationInfo ::= SEQUENCE {  servingCellId ServCellIndex OPTIONAL, -- Need S  referenceSignal CHOICE {  ssb-Index SSB-Index,  csi-RS-Index NZP-CSI-RS-ResourceId,  srs SEQUENCE {  resourceId SRS-ResourceId,  uplinkBWP BWP-Id  }  }  }  SRS-SpatialRelationInfoPos-r16 ::= SEQUENCE {  servingCellId-r16 ServCellIndex OPTIONAL, -- Need S  referenceSignal-r16 CHOICE {  ssb-IndexServing-r16 SSB-Index,  csi-RS-IndexServing-r16 NZP-CSI-RS-ResourceId,  srs-SpatialRelation-r16 SEQUENCE {  resourceSelection-r16 CHOICE {  srs-ResourceId-r16 SRS-ResourceId,  srs-PosResourceId-r16 SRS-PosResourceId-r16  },  uplinkBWP-r16 BWP-Id  },  ssbNcell-r16 SSB-InfoNcell-r16,  dl-PRS-r16 DL-PRS-Info-r16  }  }  It’s clear that the parameter level of a reference ’DL-PRS-ResourceId’ or ‘dl-PRS-ResourceSetId-r16’ is not equal to the level of 'ssb-Index', 'csi-RS-Index' and 'srs'. It is necessary to change ’DL-PRS-ResourceId’ to ’dl-PRS-r16’ in this section. |
| Qualcomm | Not a strong reason to change 'DL-PRS-ResourceId' to ‘dl-PRS-r16’. For TP2, there are more changes needed; we could change the SRS resource in this small portion, but maybe having a TP that covers more cases should be preferred. |
| Samsung | OK with proposal 4 and 5 |
| CMCC | Agree with HW. |
| LG | We have no strong preference, but it seems a reasonable change since 38.214 might be aligned with the current 38.331. |
| Intel | We do not see strong motivation to change. At the end, the reference should be to the proper DL PRS Resource. RAN2 signalling seems ensure it.  If we want to change then we propose clarification like below:  “contains the ID of a reference DL PRS resource provided by *dl-PRS-r16~~DL-PRS-ResourceId~~*’”  The following change should be done across whole spec. Let’s just make an agreement so that editors implement it.  *srs-PosResource-r16* ~~[SRS-for-positioning]~~ |
| Ericsson | no strong opinion, but we do agree that it would be clearer to use the dl-PRS-r16 since the resource ID is only unique within the resource set, and to clearly identify the PRS the TRP, resource set and resource IDs are needed |
| Sony | No strong preference. It may be good to maintain alignment with another spec (i.e 38.331) by renaming it to dl\_PRS-r16. However, it should be clearer in term of the description. We support Intel’s text proposal (in case we want to change it). |

### Conclusions

Based on the current set of comments, it seem that the TP#2 cannot be agreed. It is also noted that the parameter alignment regarding the SRS for positioning IE is taken care of in other proposed TPs.

The status is the following:

* In support of the proposals 4 and 5: CATT vivo Samsung
* Not in support of the proposals 4 and 5: Huawei/HiSilicon ZTE OPPO Qualcomm CMCC
* No strong preference: LG Intel Ericsson Sony

Based on the lack of consensus, we propose the following offline consensus:

**Proposal for offline consensus 2: proposals 4 and 5 are not agreed and TP#2 is not pursued**

Companies are encouraged to comment on the proposal for offline consensus:

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| Company | Comment |
| Sony | Support online consensus. |
| Huawei/HiSilicon | Support Proposal for offline consensus 2. |
| Qualcomm | OK |

## Aperiodic SRS for positioning in release 16 (issue 2, ,6)

### Proposals:

3 contributions [2][9][11] discuss the issue of aperiodic SRS for positioning triggered with DCI format 2\_3.

#### Parameter alignments for aperiodic SRS

The first proposal is a TP to align parameter alignment [2] (FL note: proposal was edited to allow tracking the TPs in the summary).

1. Adopt the TP in TP#3.

TP 3 : changes to table for SRS request in 38.212

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| =====================TS 38.212 clause 7.3.1.1.2 unchanged parts omitted=========================  Table 7.3.1.1.2-24: SRS request   |  |  |  | | --- | --- | --- | | Value of SRS request field | Triggered aperiodic SRS resource set(s) for DCI format 0\_1, 0\_2, 1\_1, 1\_2, and 2\_3 configured with higher layer parameter *srs-TPC-PDCCH-Group* set to 'typeB' | Triggered aperiodic SRS resource set(s) for DCI format 2\_3 configured with higher layer parameter *srs-TPC-PDCCH-Group* set to 'typeA' | | 00 | No aperiodic SRS resource set triggered | No aperiodic SRS resource set triggered | | 01 | SRS resource set(s) configured by *SRS-ResourceSet* with higher layer parameter *aperiodicSRS-ResourceTrigger* set to 1 or an entry in *aperiodicSRS-ResourceTriggerList* set to 1  SRS resource set(s) configured by *SRS-PosResourceSet-16* with an entry in *aperiodicSRS-ResourceTriggerList-r16* set to 1 | SRS resource set(s) configured with higher layer parameter *usage* in *SRS-ResourceSet* set to '*antennaSwitching*' and *resourceType* in *SRS-ResourceSet* set to 'aperiodic' for a 1st set of serving cells configured by higher layers, or  SRS resource set(s) configured by *SRS-PosResourceSet-r16* and *resourceType* in *SRS-PosResourceSet-r16* set to 'aperiodic' for a 1st set of serving cells configured by higher layers | | 10 | SRS resource set(s) configured by *SRS-ResourceSet* with higher layer parameter *aperiodicSRS-ResourceTrigger* set to 2 or an entry in *aperiodicSRS-ResourceTriggerList* set to 2  SRS resource set(s) configured by *SRS-PosResourceSet-r16* with an entry in *aperiodicSRS-ResourceTriggerList-r16* set to 2 | SRS resource set(s) configured with higher layer parameter *usage* in *SRS-ResourceSet* set to '*antennaSwitching*' and *resourceType* in *SRS-ResourceSet* set to 'aperiodic' for a 2nd set of serving cells configured by higher layers, or  SRS resource set(s) configured by *SRS-PosResourceSet-r16* and *resourceType* in *SRS-PosResourceSet-r16* set to 'aperiodic' for a 2nd set of serving cells configured by higher layers | | 11 | SRS resource set(s) configured by *SRS-ResourceSet* with higher layer parameter *aperiodicSRS-ResourceTrigger* set to 3 or an entry in *aperiodicSRS-ResourceTriggerList* set to 3  SRS resource set(s) configured by *SRS-PosResourceSet-16* with an entry in *aperiodicSRS-ResourceTriggerList-r16* set to 3 | SRS resource set(s) configured with higher layer parameter *usage* in *SRS-ResourceSet* set to '*antennaSwitching*' and *resourceType* in *SRS-ResourceSet* set to 'aperiodic' for a 3rd set of serving cells configured by higher layers, or  SRS resource set(s) configured by *SRS-PosResourceSet-r16* and *resourceType* in *SRS-PosResourceSet-r16* set to 'aperiodic' for a 3rd set of serving cells configured by higher layers |   ==================================unchanged parts omitted=============================== |

#### Triggering of Aperiodic SRS with DCI 2\_3

In [2][9], the proposal is to support Aperiodic SRS for antenna switching and SRS for positioning can be triggered with ‘DCI format 2\_3

1. Both Aperiodic SRS for antenna switching and SRS for positioning can be triggered with ‘DCI format 2\_3.

* ***With regards to ‘Type-A’ triggering,*** 
  + ***Update 38.212 Table 7.3.1.1.2-24 by removing the “or” in the corresponding column between the SRS for antenna switching and SRS for positioning.***
  + ***Update the following text in 38.214 Section 6.2.1.3***

|  |
| --- |
| *For an aperiodic SRS triggered in DCI format 2\_3 and if the UE is configured with higher layer parameter srs-TPC-PDCCH-Group set to 'typeA', and given by SRS-CarrierSwitching, without PUSCH/PUCCH transmission, the order of the triggered SRS transmission on the serving cells follow the order of the serving cells in the indicated set of serving cells configured by higher layers, where the UE in each serving cell transmits the configured one or two SRS resource set(s) with higher layer parameter usage set to 'antennaSwitching', and any SRS resource set(s)* *configured* by *SRS-PosResourceSet, ~~and~~ with higher layer parameter resourceType in SRS-ResourceSet, or SRS-PosResourceSet, set to 'aperiodic'.* |

* ***With regards to ‘Type-B’ triggering, update the following text in 38.214 Section 6.2.1.3***

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| --- |
| *For an aperiodic SRS triggered in DCI format 2\_3 and if the UE is configured with higher layer parameter srs-TPC-PDCCH-Group set to 'typeB' without PUSCH/PUCCH transmission, the order of the triggered SRS transmission on the serving cells follow the order of the serving cells with aperiodic SRS triggered in the DCI, and the UE in each serving cell transmits the configured one or two SRS resource set(s) with higher layer parameter usage set to 'antennaSwitching', and any SRS resource set(s)* *configured* by *SRS-PosResourceSet, ~~and~~ with higher layer parameter resourceType in SRS-ResourceSet, or SRS-PosResourceSet, set to 'aperiodic'.* |

In [11], it is proposed to discuss whether to support DCI triggering for both Aperiodic SRS for antenna switching and SRS for positioning in DCI 2\_3, or to only support either in a given codepoint.

1. Discuss whether option 1 or option 2 apply for aperiodic SRS

Option 1: An aperiodic SRS code point can be configured to trigger both one or several *SRS-ResourceSet* AND one or several *SRS-PosResourceSet* with the same value. Both the SRS configured in *SRS-ResourceSet* and the SRS configured by *SRS-PosResourceSet* can be transmitted.

Option 2: an aperiodic SRS code point can be configured to trigger either one or several SRS*-ResourceSet* OR one or several *SRS-PosResourceSet* with the same codepoint value. Either the SRS(s) configured by SRS*-ResourceSet* or the SRS configured by *SRS-PosResourceSet* are transmitted, but they cannot be configured to be transmitted from the same codepoint.

### Feature lead proposal

Companies are encouraged to give their view on the TP#2 from proposal 6, and discuss the issues corresponding to proposal 7 and 8. Since proposal 7 is corresponding to option 1 in proposal 8, proposal 8 can be discussed as a starting point.

### Companies comments

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | We prefer Option 1; Option 2 can be realized by gNB implementation by configuration, e.g. assigning code-point.  We also defined collision rule between mimo-SRS and pos-SRS, and we do not see issue from UE implementation when both are triggered non-overlappingly. |
| ZTE | Agree with TP3 and Option 1. |
| CATT | Support Option 1. |
| OPPO | Support Option 1. Option 2 can be achieved by gNB implementation. |
| vivo | Support proposal 6 (TP#3). Prefer option 1 in proposal 8. |
| Qualcomm | Support triggering both. (Option 1) |
| Samsung | Option 1 |
| CMCC | We support option 1. |
| LG | Support option 1 of proposal 8. |
| Intel | Option 1 |
| Huawei/HiSilicon2 | Based on the discussion from ED#1, it seem carrier switching is not supported based on the recommendation. If so, we do not need to discuss it anymore. |

### Conclusions

Based on the ED#1, aperiodic SRS for positioning with carrier switching will not be supported. The majority support triggering both SRS types if the capability is agreed.

Based on the consensus, we propose the following offline consensus:

**Proposal for offline consensus 3: if aperiodic SRS carrier switching for positioning is supported, An aperiodic SRS code point can be configured to trigger both one or several SRS-ResourceSet AND one or several SRS-PosResourceSet with the same value. Both the SRS configured in SRS-ResourceSet and the SRS configured by SRS-PosResourceSet can be transmitted (option 1 of proposal 8).**

Companies are encouraged to comment on the proposal for offline consensus:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support Proposal for offline consensus 3. |
| Qualcomm | OK |
|  |  |

## Spatial relation of SRS positioning

### Proposals

This discussion is for an alignment TP based on T2 and T3 in [3]. This TP propose to align 38.214 with 38.321 with respects to the spatial relationship.

1. Support the following TP for Clause 6.2.1 for 38.214.

TP 4 for Clause 6.2.1 for 38.214.

|  |
| --- |
| **<Unchanged part omitted>**  For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource-r16* is set to 'semi-persistent':  - when a UE receives an activation command, as described in clause 6.1.3.17 or 6.1.3.36 of [10, TS 38.321], for an SRS resource, and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and the UE assumptions on SRS transmission corresponding to the configured SRS resource set shall be applied starting from the first slot that is after slot where *μ* is the SCS configuration for the PUCCH. The activation command also contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the activated SRS resource set. When the SRS is configured with the higher layer parameter *SRS-ResourceSet*, each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the activation command if present, same serving cell and bandwidth part as the SRS resource set otherwise. When the SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16*, each ID in the list of reference signal IDs may refer to a reference SS/PBCH block on a serving or non-serving cell indicated by *PCI* field in the activation command, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the activation command if present, same serving cell and bandwidth part as the SRS resource set otherwise, or DL PRS of a serving or non-serving cell indicated by a higher layer parameter.  **<Unchanged part omitted>**  - when a UE receives an spatial relation update command, as described in clause 6.1.3.xx of [10, TS 38.321], for an SRS resource configured with the higher layer parameter *SRS-Resource*, and when the HARQ-ACK corresponding to the PDSCH carrying the update command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and the UE assumptions on updating spatial relation for the SRS resource shall be applied for SRS transmission starting from the first slot that is after slot The update command contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the updated SRS resource set. Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the update command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the update command if present, same serving cell and bandwidth part as the SRS resource set otherwise.] When the UE is configured with the higher layer parameter *usage* in *SRS-ResourceSet* set to 'antennaSwitching', the UE shall not expect to be configured with different spatial relations for SRS resources in the same SRS resource set. |

### Companies comments

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support the TP.  The first part of the TP (before <Unchanged part omitted>) concerns semi-persistent SRS for positioning. The MAC CE indication/update of the source spatial relation RS for semi-persistent SRS for positioning and MIMO SRS have some differences in 38.321 as follows   * When the indicated source spatial relation is a SSB, the corresponding cell is optionally indicated by a 5 bit *Resource Serving Cell ID* field for MIMO SRS but it is indicated by a 10 bit *PCI* field for SRS for positioning (see 38.321 Clauses 6.1.3.17 and 6.1.3.36). * When the cell corresponding to the source spatial relation SSB is the same as the serving cell of the target MIMO SRS resource, *Resource Serving Cell ID* field is not indicated. However, indicating *PCI* for the source spatial relation SSB for SRS for positioning is mandatory.   The first part of the TP corrects the current spec and clarifies this issue.  The second part of the TP (after <Unchanged part omitted>) concerns aperiodic SRS. The support for aperiodic SRS for positioning is under discussion in RAN3 and even if it will be supported in Rel-16, RAN1 has not agreed that source spatial relation update in MAC CE for aperiodic MIMO SRS is also applicable to aperiodic SRS for positioning. Even if RAN3 agree to support aperiodic SRS for positioning and RAN1 agree that source spatial relation update in MAC CE for aperiodic MIMO SRS is also applicable to aperiodic SRS for positioning, then RAN2 needs to design a new MAC CE to support spatial relation update of aperiodic SRS for positioning as the current MAC CE to support spatial relation update of aperiodic MIMO SRS cannot be directly used to aperiodic SRS for positioning (similar to the case of semi-persistent MIMO SRS vs. semi-persistent SRS for positioning). In any case, it should be clarified that the corresponding text in 38.214 is only applicable to SRS resource configured with the higher layer parameter *SRS-Resource*. |
| ZTE | Support the TP. |
| CATT | Support proposal 9. |
| OPPO | Support the TP |
| vivo | We’re okay to align parameter IE name in principle.  However, we don’t think the second part of the TP is alignment TP in any way. Given RAN2 has not specify a new MAC CE for aperiodic SRS for positioning; we prefer not to change RAN1 specification for now.  On the first part of the TP, our preference is not duplicate content if it applies to both SRS-Resource and SRS-PosResource-r16: “NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the activation command if present, same serving cell and bandwidth part as the SRS resource set otherwise”. Instead, our proposed text is:  For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource-r16* is set to 'semi-persistent':  - when a UE receives an activation command, as described in clause 6.1.3.17 or 6.1.3.36 of [10, TS 38.321], for an SRS resource, and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and the UE assumptions on SRS transmission corresponding to the configured SRS resource set shall be applied starting from the first slot that is after slot where *μ* is the SCS configuration for the PUCCH. The activation command also contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the activated SRS resource set. Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the activation command if present, same serving cell and bandwidth part as the SRS resource set otherwise. When the SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16*, each ID in the list of reference signal IDs may refer to a reference SS/PBCH block on a serving or non-serving cell indicated by *PCI* field in the activation command, or DL PRS of a serving or non-serving cell indicated by a higher layer parameter. |
| Huawei/HiSilicon2 | **Answer to Vivo:**  Regarding the first part of the TP about SP-SRS, while we in principle agree with vivo to have minimum change possible, but we do not see how Vivo’s minimalistic change would work without creating confusion to the reader. If we agree with Vivo’s suggestion, then the TP would state that, for SRS configured by *SRS-PosResource-r16,* both “reference SS/PBCH block” and “NZP CSI-RS resource” can be configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command if present, same serving cell as the SRS resource set otherwise”. While this is obviously true for “NZP CSI-RS”, it is false for SSB. Of course, later on the TP corrects itself by stating that “When the SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16*, each ID in the list of reference signal IDs may refer to a reference SS/PBCH block on a serving or non-serving cell indicated by *PCI* field in the activation command”. In our opinion, such an approach creates confusion to the reader through contradicting sentences and we believe should be avoided.  Regarding the second part of the TP about AP-SRS, we believe that it needs to be agreed and included in the updated version of the spec. As we explained above, even if RAN1 agrees that spatialrelationInfo update for AP-SRS for positioning in MAC CE is supported, the current MAC CE used for spatialrelationInfo update for AP-SRS for MIMO cannot be directly used and RAN2 should design a new MAC CE (similar to what they did for spatialrelationInfo update/indication of SP-SRS for positioning). Note also that, spatialrelationInfo update for AP-SRS for positioning in MAC CE is not supported yet in RAN1 and will not be supported in this meeting anyway (out of scope of EDs in this meeting). So, if we leave the spec as currently is, it would be erroneous in two levels: 1) It would state that spatialrelationInfo update for AP-SRS for positioning in MAC CE is supported (which is not true); 2) This support is made possible using the same MAC CE as used for the spatialrelationInfo update for AP-SRS for MIMO (which is not possible). |
| Qualcomm | OK with the first part of the TP |
| Samsung | OK with the TP |
| CMCC | We support the TP. |
| vivo2 | Response to Huawei/HiSilicon2:  As mentioned in Huawei/HiSilicon’s comment, which I quoted below.   * When the indicated source spatial relation is a SSB, the corresponding cell is optionally indicated by a 5 bit *Resource Serving Cell ID* field for MIMO SRS but it is indicated by a 10 bit *PCI* field for SRS for positioning (see 38.321 Clauses 6.1.3.17 and 6.1.3.36). * When the cell corresponding to the source spatial relation SSB is the same as the serving cell of the target MIMO SRS resource, *Resource Serving Cell ID* field is not indicated. However, indicating *PCI* for the source spatial relation SSB for SRS for positioning is mandatory.   When SRS is configured by *SRS-PosResource-r16,* there’s no “reference SS/PBCH block” configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command following the above two bullets. I don’t see where the confusion coming from. |
| Intel | The following change should be done across whole spec. Let’s just make an agreement so that editors implement it.  *srs-PosResource-r16* ~~[SRS-for-positioning]~~  Regarding TP, we suggest agreeing only the part related to SP-SRS for positioning. The AP-SRS has some uncertainty at the moment. |
| Huawei/HiSilicon3 | **Answer to Qualcomm, Intel, and Vivo regarding the second part of the TP (AP-SRS):**  We fully understand your concern that there is still an uncertainty regarding the support for AP-SRS for positioning and since it is not clear whether or not AP-SRS for positioning will be supported in Rel-16, you prefer not to touch the parts of the spec relevant AP-SRS for positioning. Obviously, our intention in the second part of the TP is not in any way to undermine the presence of AP-SRS for positioning in 38.214. Our only intention is not to let any incorrect and misleading text enter the spec.  Let’s assume for a moment that RAN3 decides that AP-SRS for positioning is supported in Rel-16. The questions that Qualcomm, Intel, and vivo may want to ask before objecting the second part of the TP are as follows:   * Question 1) Has RAN1 agreed or will RAN1 agree in this meeting that the spatialRelationInfo for AP-SRS for positioning can be updated/indicated in MAC CE? * Question 2) Even if RAN1 agree in a future meeting that the spatialRelationInfo for AP-SRS for positioning can be updated/indicated in MAC CE, can the same MAC CE that is used for updating/indicating spatialRelationInfo for Aperiodic MIMO SRS be used for updating/indicating spatialRelationInfo for Aperiodic SRS for positioning?   The answer to question 1 is obviously “No”. The answer to question 2 is also obviously “No”. RAN2 could not reuse the MAC CE for updating/indicating spatialRelationInfo for Semi-persistent MIMO SRS and had to design a new MAC CE for updating/indicating spatialRelationInfo for semi-persistent SRS for positioning. This will be the case for AP-SRS for positioning if RAN1 agree to MAC CE update of spatialRelationInfo for Aperiodic SRS for positioning in a future meeting. And this is actually why all Qualcomm and Intel and, with some modifications, vivo agreed with the first part of the TP.  Since the answer to both above Question 1 and Question 2 are “No”, we hope that Qualcomm, Intel, and vivo would agree with us that the second part of the TP is also necessary otherwise the text in 38.214 would be completely incorrect and misleading. To further trying to address Qualcomm, Intel, and vivo concern, we suggest the following conclusion to be reflected in the Chairman report:  **Conclusion:**  Agreement on TP 4 for Clause 6.2.1 for 38.214 in Feature Lead summary R1-200NNNN, does not preclude any future discussion on whether or not spatialRelationInfo for AP-SRS for positioning can be updated in MAC-CE if RAN3 agree to support AP-SRS for positioning in Rel-16.  **Answer to Vivo2 regarding the first part of the TP (SP-SRS):**  Apologies if we misunderstand your further comments in vivo2. You have quoted the two bullets in our t-doc that were provided to explain why the first part of the TP is necessary, to show that the TP is actually not necessary but we fail to understand how such a conclusion is drawn (one of the disadvantages of E-mail discussion I guess ☺). Your suggested TP that is based on a minimalistic change to the current spec is brought below where the part that we find misleading is left in black font while the rest of the TP is in grey:   |  | | --- | | For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource-r16* is set to 'semi-persistent':  - when a UE receives an activation command, as described in clause 6.1.3.17 or 6.1.3.36 of [10, TS 38.321], for an SRS resource, and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and the UE assumptions on SRS transmission corresponding to the configured SRS resource set shall be applied starting from the first slot that is after slot where *μ* is the SCS configuration for the PUCCH. The activation command also contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the activated SRS resource set. Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the activation command if present, same serving cell and bandwidth part as the SRS resource set otherwise. When the SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16*, each ID in the list of reference signal IDs may refer to a reference SS/PBCH block on a serving or non-serving cell indicated by *PCI* field in the activation command, or DL PRS of a serving or non-serving cell indicated by a higher layer parameter. |   As it is highlighted, if the above TP is agreed, it simply means that when SRS is configured by *SRS-PosResource-r16,* the list of reference IDs in the activation command contains a reference SS/PBCH block configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command if present, same serving cell as the SRS resource set otherwise. This is obviously incorrect. Nothing that comes after (including the last three lines in the text) **reverts** the above incorrect statement. They are **only additional** information specific to SRS configured by *SRS-PosResource-r16*.  As such, we believe that the first part of our proposed TP is required to avoid such misleading text to enter the specification. |
| vivo3 | Response to Huawei/HiSilicon3:  Thanks for the follow-up. Our understanding of the text in TS 38.214 “The activation command also contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the activated SRS resource set. …” is just a brief and general description of what reference signals could be contained in the activation command for spatial relationship where details are described in TS 38.321.  Thanks for checking and our previous TP does miss one case. The following is Figure 6.1.3.36-3 copied from TS 38.321 v16.0.0.    Figure 6.1.3.36-3: Spatial Relation for Resource IDi with SSB  So when SRS is configured by *SRS-PosResource-r16*, if the list of reference IDs in the activation command contains a reference SS/PBCH block, then *PCI* field is always indicated but not *Resource Serving Cell ID* field.  Here’s our revised TP for this part.   |  | | --- | | For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource-r16* is set to 'semi-persistent':  - when a UE receives an activation command, as described in clause 6.1.3.17 or 6.1.3.36 of [10, TS 38.321], for an SRS resource, and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and the UE assumptions on SRS transmission corresponding to the configured SRS resource set shall be applied starting from the first slot that is after slot where *μ* is the SCS configuration for the PUCCH. The activation command also contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the activated SRS resource set. Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* or *PCI* field in the activation command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the activation command if present, same serving cell and bandwidth part as the SRS resource set otherwise. When the SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16*~~[SRS-for-positioning]~~, each ID in the list of reference signal IDs may also refer to a reference SS/PBCH block of a non-serving cell indicated by *PCI* field in the activation command, or DL PRS of a serving or non-serving cell indicated by a higher layer parameter. | |
| Huawei/HiSilicon4 | **Answer to Vivo in Vivo3**  Thanks vivo for the constructive comments. The proposed TP in Vivo3 still indicates that PCI field is optional in MAC CE for spatialrelationInfo update of SRS for positioning (it is not present if the SSB is associated from the same cell as the SRS resource for positioning):   |  | | --- | | **Excerpt from vivo TP in Vivo3:**  Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* or *PCI* field in the activation command if present, same serving cell as the SRS resource set otherwise, |   Our understanding is that PCI is not optional even if it refers to the same serving cell as the SRS resource for positioning. 38.321 is quite clear about it   |  | | --- | | **Excerpt from 38.321 Clause 6.1.3.36 (underscore from us):**  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**.  […]  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; |   As such, we believe that our TP more accurately captures the MAC CE for SRS for positioning spatialRelationInfo. We are of course open to further suggestions from vivo if the issue regarding mandatory PCI being rectified. |
| vivo4 | Response to Huawei/HiSilicon4:  Again, thanks for the follow-up.  First of all, I didn’t interpret from “Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* or *PCI* field in the activation command if present, same serving cell as the SRS resource set otherwise, ” that *PCI* field is optional. In fact, as you and I quoted from TS 38.321, *PCI* field is always there when SRS is configured by *SRS-PosResource-r16* and if the list of reference IDs in the activation command contains a reference SS/PBCH block.  With that, I don’t see any confusion because it says “Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* or *PCI* field in the activation command if present”. When a UE receives an activation command, as described in clause 6.1.3.17 or 6.1.3.36 of [10, TS 38.321], it checks if *Resource Serving Cell ID* or *PCI* field present in the activation command and finds *PCI* field present. In that case, I don’t see why the UE will disregard the first half of sentence and interpret only the last part of sentence “same serving cell as the SRS resource set otherwise”. |
| Huawei/HiSilicon5 | **Response to Vivo4:**  Thanks Vivo for the reply in vivo4. Unfortunately, Our concern with vivo’s alternative text still persists. Let us again refer to the part of the suggested text by vivo below that we are concerned about   |  | | --- | | **Excerpt from vivo TP in Vivo3:**  Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* or *PCI* field in the activation command if present, same serving cell as the SRS resource set otherwise, |   Above text has two distinct inaccuracies:   1. For SRS for positioning, associated cell with reference NZP CSI-RS is only indicated by *Resource Serving Cell ID* and the associated cell with SS/PBCH block is only indicated by PCI. However, above text lumps all cases together and states that the associated cell with SS/PBCH block or NZP CSI-RS may be indicated Resource Serving Cell ID or PCI. 2. The second and more important problem is that, for SRS for positioning, PCI is always present. The above text obviously says that PCI may be not present:   “**PCI field in the activation command if present,** same serving cell as the SRS resource set otherwise”.  We really cannot interpret this otherwise and we wonder how this can be interpreted otherwise.    Since the suggested text in TP 4 has neither of the above two problems, we still believe that the text in TP 4 is the better alternative. |
| vivo5 | Response to Huawei/HiSilicon5:  Again, thanks for the follow-up.  Talking about inaccuracies and matching to TS 38.321, there’re other mandatory and optional fields contained in the activation command described in TS 38.321 which are not even mentioned in TS 38.214.  I found the debate on whether the wording ‘if present’ means optional rather pointless. I’ll let other companies to check. If all other companies are okay with TP4, we can live with it. |
| ericsson | Support the proposal and TP4. |
| Sony | Support the aforementioned text proposal. |

### Conclusions

Based on the latest comments, it seems that TP4 is agreeable at least regarding the SP SRS section. For AP SRS, there are several companies who do not want to change the section.

Based on the consensus, we propose the following offline consensus based on the first part of the TP. Companies are encouraged to continue discussing regarding the second part of the TP:

**Proposal for offline consensus 4: the following text proposal (TP4b) is endorsed**

**TP 4b for Clause 6.2.1 for 38.214.**

|  |
| --- |
| **<Unchanged part omitted>**  For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource-r16* is set to 'semi-persistent':  - when a UE receives an activation command, as described in clause 6.1.3.17 or 6.1.3.36 of [10, TS 38.321], for an SRS resource, and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and the UE assumptions on SRS transmission corresponding to the configured SRS resource set shall be applied starting from the first slot that is after slot where *μ* is the SCS configuration for the PUCCH. The activation command also contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the activated SRS resource set. When the SRS is configured with the higher layer parameter *SRS-ResourceSet*, each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the activation command if present, same serving cell and bandwidth part as the SRS resource set otherwise. When the SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16*, each ID in the list of reference signal IDs may refer to a reference SS/PBCH block on a serving or non-serving cell indicated by *PCI* field in the activation command, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the activation command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the activation command if present, same serving cell and bandwidth part as the SRS resource set otherwise, or DL PRS of a serving or non-serving cell indicated by a higher layer parameter.  **<Unchanged part omitted>** |

Companies are encouraged to comment on the proposal for offline consensus:

|  |  |
| --- | --- |
| Company | Comment |
| Sony | Support |
| Huawei/HiSilicon | OK with TP4b.  Regarding the second part of TP4 about AP-SRS for positioning, we are just wondering if we can have one last try to converge. We find this issue very important to avoid incorrect information enter the spec (for the details of our reasoning, please see Huawei/HiSilicon3: Answer to Qualcomm, Intel, and Vivo regarding the second part of the TP (AP-SRS)) where we have explained why it is important to agree on this part of TP4 and also tried to address opposing companies’ concern by proposing the following conclusion:  **Conclusion:**  Agreement on TP 4 for Clause 6.2.1 for 38.214 in Feature Lead summary R1-200NNNN, does not preclude any future discussion on whether or not spatialRelationInfo for AP-SRS for positioning can be updated in MAC-CE if RAN3 agree to support AP-SRS for positioning in Rel-16.  Since there are 7 companies that support TP4 as a whole (including the second part of the TP) and the three opposing companies did not raise any further concern about the second part of the TP after our above proposed conclusion, we would like to ask Qualcomm, Intel, and vivo if they can also agree with the second part of TP4 conditioned on the inclusion of the above Conclusion in the Chairman Report. |
|  |  |

## SRS collisions (issue 5a, b)

### Proposals

The proposal T4 in [3] is a clarification of the collision rule between PUSCH and the SRS for positioning. the associated text proposal clarifies that the collision rule applies for operations in the same carrier.

1. Support the following TP for Clause 6.2.1.4 for 38.214.

TP 5 for Clause 6.2.1.4 for 38.214.

|  |
| --- |
| **<Unchanged part omitted>**  For operation on the same carrier, if an SRS configured by the higher parameter *SRS-PosResource-r16* collides with a scheduled PUSCH, the SRS is dropped in the symbols where the collision occurs.  **<Unchanged part omitted>** |

The proposal for TP-A in [4] is to reword single carrier operations to “operations on the same carriers”

1. Adopt the following text proposal (TP-A) for simultaneous SRS-Pos transmission in a single symbol in 38.214:

TP 6 for Clause 6.2.1.4 for 38.214.

|  |
| --- |
| *-----------------------------------------------Start of Text Proposal for 38.214----------------------------------------------*  6.2.1.4 UE sounding procedure for positioning purposes  *-----------------------------------------------------* Unchanged part omitted *------------------------------------------------*  For operations in the same carrier, the UE is not expected to be configured on overlapping symbols with more than one SRS resources configured by the higher layer parameter *srs-PosResource-r16* with *resourceType* of the SRS resources as ‘periodic’.  For operations in the same carrier, the UE is not expected to be triggered to transmit SRS on overlapping symbols with more than one SRS resources configured by the higher layer parameter *srs-PosResource-r16* with *resourceType* of the SRS resources as ‘semi-persistent’ or ‘aperiodic’.  *-----------------------------------------------------* Unchanged part omitted *------------------------------------------------ --------------------------------------------------------End of Text Proposal --------------------------------------------------* |

### Companies comments

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | We support TP 5.  As discussed in [3], if the clarification is not made that dropping the colliding SRS symbols only applies to operation on the same carrier, then the original text in the spec in TP 5 would remain contradicting with the following part of the spec:   |  | | --- | | 38.214 Clause 6.2.1:  In case of intra-band carrier aggregation or in inter-band CA band-band combination where simultaneous SRS and PUCCH/PUSCH transmissions are not allowed, a UE is not expected to be configured with SRS from a carrier and PUSCH/UL DM-RS/UL PT-RS/PUCCH formats from a different carrier in the same symbol. |   Above text in the box says that UE is not expected to be configured with SRS from a carrier and PUSCH from a different carrier in the same symbol in Intra-band CA or Inter-band CA band-band combination where simultaneous SRS and PUSCH transmissions are not allowed (such simultaneous configuration is an “error case” and cannot be handled just by dropping colliding SRS symbols).  We support TP 6. |
| ZTE | Support TP 5 and TP 6. |
| CATT | Support proposal 10 and proposal 11. TP 6 is reasonable as the modifications in TP 6 can align the description to the common wording in the specifications, and avoid ambiguity of single carrier operations by using the same carrier instead of single carrier. |
| OPPO | Support TP5 and TP 6 |
| vivo | Okay with TP5 and TP 6 |
| Nokia/NSB | Okay with TPs 5 and 6. |
| Qualcomm | OK with TP 5 & 6 |
| Samsung | OK with TP 5,6 |
| CMCC | We support TP5 and TP6. |
| LG | Support TP5 and TP6. |
| Intel | Agree on TP5 and TP6 |
| Sony | OK with TP 5 & 6 |

### Conclusions

Based on the consensus to support TP5 and TP6 from the comments above, the following offline consensus is proposed

**Proposal for offline consensus 5: TP5 and TP6 are endorsed for inclusion in 38.214.**

## Simultaneous transmission of SRS-mimo and SRS-pos in CA (issue 15)

The following is proposed in [8].

1. For intra-band and inter-band CA operations, support the simultaneous transmission of SRS resource for positioning and SRS resource for MIMO.

For intra-band and inter-band CA operations, a UE can simultaneously transmit more than one SRS resources configured by SRS-PosResource-r16 and SRS-Resource on different CCs, subject to UE’s capability

### Companies comments

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support. |
| CATT | Don’t support proposal 12.  Although it had been agreed that introducing a new UE capability for the number of SRS resources for positioning on a symbol for intra-band CA, which means multiple SRS-Pos may be transmitted on a symbol in different CCs subjected to UE’s capability, we see some issues for supporting SRS-Pos and SRS-MIMO transmitted on the same symbol in different CCs. For intra-band CA case, suppose SRS-Pos and SRS-MIMO are transmitted in different CCs, intra-band collision for inter-feature “SRS-Pos + SRS-MIMO” on overlapping symbols is different with intra-feature “SRS-Pos + SRS-Pos”, as SRS-MIMO may take up large proportion of Tx power on overlapping symbols, therefore will affect the transmission power of SRS-Pos, or vice versa. However, “SRS-Pos + SRS-Pos” can easily avoid such issue by intra-feature coordination.  Therefore, we suggest to adopt the following text proposal for intra-band collision between SRS-Pos and SRS-MIMO in 38.214:   |  | | --- | | *--------------------------------Start of Text Proposal for 38.214----------------------------------------------*  6.2.1 UE sounding procedure  *-----------------------------------* Unchanged part omitted *------------------------------------------------*  For operations in the same carrier or intra-band CA case(when a SRS resource configured by the higher layer parameter *srs-PosResource-r16* and a SRS resource configured by the higher layer parameter SRS-Resource are in different component carriers), the UE is not expected to be configured on overlapping symbols with a SRS resource configured by the higher layer parameter *srs-PosResource-r16* and a SRS resource configured by the higher layer parameter SRS-Resource with *resourceType* of both SRS resources as ‘periodic’.  For operations in the same carrier or intra-band CA case(when a SRS resource configured by the higher layer parameter *srs-PosResource-r16* and a SRS resource configured by the higher layer parameter SRS-Resource are in different component carriers), the UE is not expected to be triggered to transmit SRS on overlapping symbols with a SRS resource configured by the higher layer parameter *srs-PosResource-r16* and a SRS resource configured by the higher layer parameter SRS-Resource with *resourceType* of both SRS resources as ‘semi-persistent’ or ‘aperiodic’.  *---------------------------------------* Unchanged part omitted *--------------------------------------*  *---------- -------------------End of Text Proposal --------------------------------------------------* | |
| OPPO | Support. The issue pointed out by CATT can be avoid via gNB implementation since both SRS are configured / triggered by gNB. |
| Vivo | We don’t view this proposal as an essential correction in any sense. It’s not clear to us about the motivation/benefit of this proposal especially given SRS for positioning does not support closed loop power control and hence complicated to support simultaneous transmission of SRS-MIMO and SRS for positioning on the same symbol. |
| Nokia/NSB | We are okay with the proposal but agree with vivo that we do not see this as critical. |
| Qualcomm | We are OK with the proposal. I assume the UE’s capability that the proposal is referring to is the capability that we introduced for SRS-Pos+SRS-Pos simultaneous reception in intra-band/inter-band CA. |
| Samsung | Support |
| CMCC | We support the TP. |
| LG | Support. We think that UEs which are capable of simultaneous transmission of SRS for positioning also could be possible to simultaneous transmission of SRS for positioning and SRS for MIMO. |
| Intel | Do not see it as critical. Accept it for the sake of progress. |
| Support. |  |

### Conclusions

The majority of comments support the proposals, with one company not supporting a 3 companies considering it not critical.

Based on the consensus to support the proposals the following offline consensus is proposed:

**Proposal for offline consensus 6: proposal 12 is endorsed:**

* **For intra-band and inter-band CA operations, support the simultaneous transmission of SRS resource for positioning and SRS resource for MIMO.**
* **For intra-band and inter-band CA operations, a UE can simultaneously transmit more than one SRS resources configured by SRS-PosResource-r16 and SRS-Resource on different CCs, subject to UE’s capability**

DL PRS corrections

## Aspect 4-1. Extension to the case of multiple serving cells

### Proposal:

The TS 38.211 does not capture the case when there is more than one serving cell. Thus, it is proposed to make the following correction to cover the case when there is more than one serving cell[16].

TP 7

|  |
| --- |
| **TS 38.211 Clause 7.4.1.7.3 Mapping to physical resources in a downlink PRS resource** […]  - the resource element is within the resource blocks occupied by the downlink PRS resource for which the UE is configured;  - the symbol is not used by any SS/PBCH block used by ~~the~~ a serving cell for downlink PRS transmitted from the same serving cell or any SS/PBCH block from a non-serving cell indicated by the higher-layer parameter *ssb-PositionsInBurst-r16* for downlink PRS transmitted from the same non-serving cell;  - the slot number satisfies the conditions in clause 7.4.1.7.4.   * […] |

### Companies comments

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support. |
| ZTE | Support. |
| CATT | Support TP 7. |
| OPPO | Support |
| vivo | Support TP7 |
| Nokia/NSB | Okay with TP. |
| Qualcomm | OK |
| Samsung | OK |
| CMCC | Fine with the TP |
| LG | Support. |
| Intel | OK |

### Conclusions

Based on the latest comments, it seems that TP7 is agreeable and we propose the following offline consensus

**Proposal for offline consensus 7: Text proposal TP7 is endorsed**

## Aspect 7-1 and 10-1. Change the higher layer parameter of combOffset to dl-PRS-ReOffset-r16

### Proposals:

Two proposals with the same TP impact where proposed to align the name for comb offset to the correct IE[19][22]:

TP 8

|  |
| --- |
| **In TS 38.211 Section 7.4.1.7**  - the comb size is given by the higher-layer parameter *dl-PRS-CombSizeN-r16* such that the - combination is one of {2, 2},{4, 2}, {6, 2}, {12, 2}, {4, 4}, {12, 4}, {6, 6}, {12, 6} and {12, 12};  - the resource-element offset is given by the higher-layer parameter *~~combOffset~~ dl-PRS-ReOffset-r16*;  - the quantity is given by Table 7.4.1.7.3-1. |

### Companies comments

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | OK. |
| ZTE | Fine with the TP. |
| CATT | Support TP 8. |
| OPPO | Support |
| vivo | Support |
| Nokia/NSB | Okay with TP. |
| Qualcomm | OK |
| Samsung | OK |
| CMCC | Support |
| LG | Support |
| Intel | OK |
| Sony | OK |

### Conclusions

Based on the latest comments, it seems that TP8 is agreeable and we propose the following offline consensus

**Proposal for offline consensus 8: Text proposal TP8 is endorsed**

## Aspect 8-2. Clarification on dl-PRS-ResourceSymbolOffset-r16

### Proposal

It is proposed to adopt the following TP on Section 5.1.6.5 of TS 38.214 + add spacing after parameter names[22]

TP 9

|  |
| --- |
| 5.1.6.5 PRS reception procedure  ---- Unchanged parts are omitted ----  *- dl-PRS-ResourceSymbolOffset-r16* determines the starting symbol of a slot configured with the DL PRS resource.  ---- Unchanged parts are omitted ---- |

Feature lead response:

* Seems more accurate wording is proposed in this editorial correction

### Companies comments

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | OK. |
| ZTE | Agree. |
| CATT | Support TP 9. |
| OPPO | Support |
| vivo | Not an essential correction. Okay with TP9 |
| Nokia/NSB | The current wording is clear in our view and this is not an essential correction. Do not support. |
| Qualcomm | Not really essential |
| Samsung | OK |
| CMCC | Support |
| LG | Support |
| Intel | Seems a bit more accurate wording is proposed in this editorial correction. Support |
| Sony | Support |

### Conclusions

Based on the latest comments, it seems that TP7 is having majority support with 3 companies either not supporting or deeming the change not essential. We propose the following offline consensus

**Proposal for offline consensus 9: Text proposal TP9 is endorsed**

Companies are encouraged to comment on the proposal for offline consensus:

|  |  |
| --- | --- |
| Company | Comment |
| Sony | Support the above offline consensus |
| Huawei/HiSilicon | Support |
|  |  |

## Aspect 10-2. TP on PRS muting to the TS 38.211 Section 7.4.1.7.4

### Proposal:

Proposed TP aligns RAN1 specification with RAN2 specification[22]

TP 10

|  |
| --- |
| TS 38.211  7.4.1.7.4 Mapping to slots in a downlink PRS resource set  \*\*\*\*\* unchanged text is omitted \*\*\*\*\*\*\*\*\*\*\*  - the higher-layer parameter *mutingOption1-r16~~DL-PRS-MutingPattern~~* is provided ~~and~~ with bitmap but ~~not~~ *mutingOption2-r16* with bitmap is not provided, and bit is set;  - the higher-layer parameter *mutingOption2-r16~~DL-PRS-MutingPattern~~*is provided ~~and~~ with bitmap but not *mutingOption1-r16* with bitmap is provided, and bit is set;  \*\*\*\*\* unchanged text is omitted \*\*\*\*\*\*\*\*\*\*\* |

### Companies comments

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | I checked the latest version, the proposed change seems only to move “not” to make the text in 38.211 section 7.4.1.7.4 on muting grammatically correct.   |  | | --- | | - the higher-layer parameter *mutingOption1-r16* is provided with bitmap but not *mutingOption2-r16* with bitmap is provided, and bit is set;  - the higher-layer parameter *mutingOption2-r16* is provided with bitmap but not *mutingOption1-r16* with bitmap is provided, and bit is set; |   However, why hasn’t the second paragraph been changed? |
| CATT | Support TP 10. |
| Nokia/NSB | Agree with Huawei that the text should be aligned in both bullets. Okay in principle with the TP. |
| Qualcomm | OK in principle; both bullets should be aligned |
| CMCC | Share same views as HW, Nokia and QC. |
| LG | In consideration of above comments from companies, it might be simply agreeable with minor change as follows.  - the higher-layer parameter *mutingOption1-r16~~DL-PRS-MutingPattern~~* is provided ~~and~~ with bitmap but ~~not~~ *mutingOption2-r16* with bitmap is not provided, and bit is set;  - the higher-layer parameter *mutingOption2-r16~~DL-PRS-MutingPattern~~*is provided ~~and~~ with bitmap but ~~not~~ *mutingOption1-r16* with bitmap is not provided, and bit is set; |
| Intel | Agree to any version with aligned wording. |
| Ericsson | Agree with the update on the TP. |
| Sony | Same view as QC |

### Conclusions

Based on the comments, the TP is agreeable with alignment to update the second bullet in the list by moving the “not” statement there as well. The following offline consensus is proposed:

**Proposal for offline consensus 10: the following TP (TP 10b) is agreed:**

TP 10b

|  |
| --- |
| TS 38.211  7.4.1.7.4 Mapping to slots in a downlink PRS resource set  \*\*\*\*\* unchanged text is omitted \*\*\*\*\*\*\*\*\*\*\*  - the higher-layer parameter *mutingOption1-r16~~DL-PRS-MutingPattern~~* is provided ~~and~~ with bitmap but ~~not~~ *mutingOption2-r16* with bitmap is not provided, and bit is set;  - the higher-layer parameter *mutingOption2-r16~~DL-PRS-MutingPattern~~*is provided ~~and~~ with bitmap but ~~not~~ *mutingOption1-r16* with bitmap is not provided, and bit is set;  \*\*\*\*\* unchanged text is omitted \*\*\*\*\*\*\*\*\*\*\* |

Companies are encouraged to comment on the proposal for offline consensus:

|  |  |
| --- | --- |
| Company | Comment |
| Sony | Support |
| Huawei/HiSilicon | Support TP10b |
|  |  |

## Aspect 4-3 AND 10-3 TP to clarify muting operation TS 38.214 Section 5.1.6.5

### Proposals

The description in 38.214 may provide a wrong impression that *dl-PRS-MutingPatternList-r16* only defines one bitmap that has different meanings for the different options. However, from the IE structure of the *dl-PRS-MutingPatternList*, it is clear that *DL-PRS-MutingPatternList* contains two individual bitmaps (*mutingPatterns*): one for *mutingOption1* and the other for *mutingOption2*. The two bitmaps can be configured independently with different lengths, e.g., for option 1, the length of the bitmap can be {2, 4, 6, 8, 16, 32} bits, while for Option 2, the length of the bitmap should be the same as *dl-PRS-ResourceRepetitionFactor-r16.* [16]

TP 11

|  |
| --- |
| 5.1.6.5 PRS reception procedure […]  *- dl-PRS-MutingPatternList-r16* defines ~~a bitmap of~~ the time locations where the DL PRS resource is expected to not be transmitted for a DL PRS resource set. ~~The bitmap size can be {2, 4, 6, 8, 16, 32} bits long.~~ ~~The bitmap has two options for applicability.~~ If *mutingOption1* is configured , ~~In the first option~~ each bit in the bitmap of *mutingOption1* corresponds to a configurable number provided by higher layer parameter *dl-PRS-MutingBitRepetitionFactor-r16* of consecutive instances of a DL PRS resource set where all the DL PRS resources within the set are muted for the instance that is indicated to be muted. The length of the bitmap can be {2, 4, 6, 8, 16, 32} bits. If *mutingOption2* is configured each bit in the bitmap of *mutingOption2* corresponds to a single repetition index for each of the DL PRS resources within each instance of a *nr-DL-PRS-ResourceSet-r16* and the length of the bitmap is equal to the values of *dl-PRS-ResourceRepetitionFactor-r16*. Both *mutingOption1 and mutingOption2* may be configured at the same time in which case the logical AND operation is applied to the bit maps as described in Clause 7.4.1.7.4 of [4, TS 38.211].   * […] |

In 38.214, the description of PRS muting does not include the name of the different parameters for the bitmap and the muting options. Corrections are provided in the TP below[22]:

TP 12

|  |
| --- |
| TS 38.214  5.1.6.5 PRS reception procedure  \*\*\*\*\* unchanged text omitted \*\*\*\*\*\*\*\*\*\*\*  *dl-PRS-MutingPatternList-r16* defines a bitmap of the time locations where the DL PRS resource is expected to not be transmitted for a DL PRS resource set. The bitmap is configured by the parameter *mutingPattern-r16* with a size ~~can be~~ {2, 4, 6, 8, 16, 32} bits long. The bitmap has two options for applicability. In the first option set by the parameter *mutingOption1-r16* each bit in the bitmap corresponds to a configurable number provided by higher layer parameter *dl-PRS-MutingBitRepetitionFactor-r16* of consecutive instances of a DL PRS resource set where all the DL PRS resources within the set are muted for the instance that is indicated to be muted. In the second option set by the parameter *mutingOption2-r16* each bit in the bitmap corresponds to a single repetition index for each of the DL PRS resources within each instance of a *nr-DL-PRS-ResourceSet-r16*and the length of the bitmap is equal to the values of *dl-PRS-ResourceRepetitionFactor-r16*. Both options may be configured at the same time in which case the logical AND operation is applied to the bit maps as described in Clause 7.4.1.7.4 of [4, TS 38.211].  \*\*\*\*\* unchanged text omitted \*\*\*\*\*\*\*\*\*\*\* |

### Companies comments

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | We think the changes are duplicated from the equation from TS 38.211.   |  | | --- | | For a downlink PRS resource in a downlink PRS resource set, the UE shall assume the downlink PRS resource being transmitted when the slot and frame numbers fulfil  and one of the following conditions are fulfilled:  - the higher-layer parameter *dl-PRS-MutingPatternList-r16* is not provided;  - the higher-layer parameter *mutingOption1-r16* is provided with bitmap but not *mutingOption2-r16* with bitmap is provided, and bit is set;  - the higher-layer parameter *mutingOption2-r16* is provided with bitmap but not *mutingOption1-r16* with bitmap is provided, and bit is set;  - the higher-layer parameters *mutingOption1-r16* with bitmap and *mutingOption2-r16* with are both provided, and both bit and are set.  where  - is bit in the bitmap given by the higher-layer parameter *mutingOption1-r16* where is the size of the bitmap;  - is bit in the bitmap given by the higher-layer parameter *mutingOption2-r16;* |   To us, the current TS 38.211 has already provided the correct and self-explanatory understanding of the muting configuration and is written so elegantly that any explanation in TS 38.214 is useless. We propose to only capture the following in TS 38.214.  *mutingOption1-r16* and *mutingOption2-r16* define the DL PRS muting configuration as described in Clause 7.4.1.7.4 of [4, TS 38.211]. |
| ZTE | Agree with Huawei for simplification. |
| CATT | We prefer to adopt TP 11 for 38.214.  We suggest TP 11 should be adopted because it is obvious that the current description “*dl-PRS-MutingPatternList-r16”* in TS 38.214 does not match the requirements in TS 38.211 and TS 37.355, as we explained in the tdoc. We understand UE/gNB would most likely follow TS 38.211/37.355 in muting implementation, but it is still important that TS 38.214 provides a correct description for the parameter. |
| OPPO | Support TP 11 |
| vivo | Our understanding of TP 11 and TP 12 is that they are addressing the same issue. Okay with either one. |
| Nokia/NSB | We are okay to add the IE names for the mutingOptions but otherwise this TP seems overkill as TS 38.211 explains the behaviour and 214 points to it already. |
| CMCC | OK with TP11. |
| LG | We prefer TP 11. |
| Intel | Prefer to avoid duplication b/w 211 and 214. Agree with proposal from Huawei. |
| Ericsson | Preference for TP12 but any TP that closes the issue will be fine. We would like to see the TP from Huawei proposal so that we can understand the proposal in context. |
| Sony | Agree with the proposal from HW |

### Conclusions

TBD

## Aspect 7-2. Corrections to TS 38.214

### proposal[19]

* Description on the configurations of positioning frequency layer, DL PRS resource set, DL PRS resource in TS 38.214 accordingly
* TRP should be used instead of cell
* DL-PRS-ResourceSymbolOffset not only determines the starting symbol of the DL PRS resource within the starting slot, but also that within the other slot used for transmission.
* SS/PBCH Blocks with the same SSB index may be from the same beam, or may be from different beams, since SS/PBCH block with the same SSB index may be from different servicing cells
* The condition “as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met” should refer to the case with different DL PRS resource rather than different LD PRS resource sets block with the same SSB index may be from different servicing cells
* The condition “as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met” should refer to the case with different DL PRS resource rather than different LD PRS resource sets

TP 13

|  |
| --- |
| **In TS 38.214 Section 5.1.6.5 (CR R1-2001731)**  5.1.6.5 PRS reception procedure  **<omitted text>**  The UE expects that it will be configured with *~~dl-PRS-ID-r16~~ TRP-ID-r16* each of which is defined such that it is associated with multiple DL PRS resource sets from the same cell. The UE expects that one of these *~~dl-PRS-ID-r16~~ TRP-ID-r16* along with a *nr-DL-PRS-ResourceSetId-r16* and a *nr-DL-PRS-ResourceId-r16* can be used to uniquely identify a DL PRS resource.  **<omitted text>**  A DL PRS resource is defined by:  **<omitted text>**  *- dl-PRS-ResourceSlotOffset-r16*determines the starting slot of the DL PRS resource with respect to corresponding DL PRS resource set slot offset  *- dl-PRS-ResourceSymbolOffset-r16* determines the starting symbol of the DL PRS resource within the ~~starting~~ slot.  *- dl-PRS-NumSymbols-r16*defines the number of symbols of the DL PRS resource within a slot where the allowable values are given in Clause 7.4.1.7.1 of [4, TS38.211].  *- dl-PRS-QCL-Info-r16*defines any quasi-colocation information of the DL PRS resource with other reference signals. The DL PRS may be configured to be ‘QCL-Type-D’ with a DL PRS or SS/PBCH Block from a serving cell or a non-serving cell. The DL PRS may be configured to be ‘QCL-Type-C’ with a SS/PBCH Block from a serving or non-serving cell. If the DL PRS is configured as both ‘QCL-Type-C’ and ‘QCL-Type-D’ with a SS/PBCH Block then the SSB index indicated should be the same and should be from the same cell.  The UE assumes constant EPRE is used for all REs of a given DL PRS resource.  The UE may be indicated by the network that a DL PRS resources can be used as the reference for the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo-r16*. The reference indicated by the network to the UE can also be used by the UE to determine how to apply higher layer parameters *nr-DL-PRS-expectedRSTD-r16*and *nr-DL-PRS-expectedRSTD-uncerainty-r16*. The UE expects the reference to be indicated whenever it is expected to receive the DL PRS. This reference provided by *nr-DL-PRS-ReferenceInfo-r16*may include an *dl-PRS-ID-r16*, a DL PRS resource set ID, and optionally a single DL PRS resource ID or a list of DL PRS resource IDs. The UE may use different DL PRS resources as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met or a different DL PRS resource set to determine the reference for the RSTD measurement ~~as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met~~. If the UE chooses to use a different reference than indicated by the network, then it is expected to report the *dl-PRS-ID-r16*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference.  **<omitted text>**  The UE may be configured to measure and report, subject to UE capability, up to 4 DL RSTD measurements per pair of ~~cells~~ *TRP-ID-r16* with each measurement between a different pair of DL PRS resources or DL PRS resource sets within the DL PRS configured for those ~~cells~~ *TRP-ID-r16*. The up to 4 measurements being performed on the same pair of cells and all DL RSTD measurements in the same report use a single reference timing.  The UE may be configured to measure and report, subject to UE capability, up to 8 DL PRS RSRP measurements on different DL PRS resources ~~from the same cell~~ associated with the same *TRP-ID-r16*. When the UE reports DL PRS RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS RSRP measurements have been performed using the same spatial domain filter for reception.  The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements corresponding to a single configured SRS resource or resource set for positioning. Each measurement corresponds to a single received DL PRS resource or resource set which can be in different positioning frequency layers.  If the UE is configured with *dl-PRS-QCL-Info-r16*and the QCL relation is between two DL PRS resources, then the UE assumes those DL PRS resources are ~~from the same cell~~ associated with the same *TRP-ID-r16*. If *dl-PRS-QCL-Info-r16*is configured to the UE with ‘QCL-Type-D’ with a source DL-PRS-Resource then the *nr-DL-PRS-ResourceSetId-r16*and the *nr-DL-PRS-ResourceId-r16*of the source DL PRS resource are expected to be indicated to the UE.  **<omitted text>** |

TP 13-1

|  |
| --- |
| **In TS 38.214 Section 5.1.6.5 (CR R1-2001731)**  5.1.6.5 PRS reception procedure  **<omitted text>**  The UE expects that it will be configured with *~~dl-PRS-ID-r16~~ TRP-ID-r16* each of which is defined such that it is associated with multiple DL PRS resource sets from the same cell. The UE expects that one of these *~~dl-PRS-ID-r16~~ TRP-ID-r16* along with a *nr-DL-PRS-ResourceSetId-r16* and a *nr-DL-PRS-ResourceId-r16* can be used to uniquely identify a DL PRS resource.  **<omitted text>**  A DL PRS resource is defined by:  **<omitted text>**  *- dl-PRS-ResourceSlotOffset-r16*determines the starting slot of the DL PRS resource with respect to corresponding DL PRS resource set slot offset  *- dl-PRS-ResourceSymbolOffset-r16* determines the starting symbol of the DL PRS resource within the starting slot.  *- dl-PRS-NumSymbols-r16*defines the number of symbols of the DL PRS resource within a slot where the allowable values are given in Clause 7.4.1.7.1 of [4, TS38.211].  *- dl-PRS-QCL-Info-r16*defines any quasi-colocation information of the DL PRS resource with other reference signals. The DL PRS may be configured to be ‘QCL-Type-D’ with a DL PRS or SS/PBCH Block from a serving cell or a non-serving cell. The DL PRS may be configured to be ‘QCL-Type-C’ with a SS/PBCH Block from a serving or non-serving cell. If the DL PRS is configured as both ‘QCL-Type-C’ and ‘QCL-Type-D’ with a SS/PBCH Block then the SSB index indicated should be the same and should be from the same cell.  The UE assumes constant EPRE is used for all REs of a given DL PRS resource.  The UE may be indicated by the network that a DL PRS resources can be used as the reference for the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo-r16*. The reference indicated by the network to the UE can also be used by the UE to determine how to apply higher layer parameters *nr-DL-PRS-expectedRSTD-r16*and *nr-DL-PRS-expectedRSTD-uncerainty-r16*. The UE expects the reference to be indicated whenever it is expected to receive the DL PRS. This reference provided by *nr-DL-PRS-ReferenceInfo-r16*may include an *dl-PRS-ID-r16*, a DL PRS resource set ID, and optionally a single DL PRS resource ID or a list of DL PRS resource IDs. The UE may use different DL PRS resources or a different DL PRS resource set to determine the reference for the RSTD measurement as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met. If the UE chooses to use a different reference than indicated by the network, then it is expected to report the *dl-PRS-ID-r16*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference.  **<omitted text>**  The UE may be configured to measure and report, subject to UE capability, up to 4 DL RSTD measurements per pair of ~~cells~~ *TRP-ID-r16* with each measurement between a different pair of DL PRS resources or DL PRS resource sets within the DL PRS configured for those ~~cells~~ *TRP-ID-r16*. The up to 4 measurements being performed on the same pair of cells and all DL RSTD measurements in the same report use a single reference timing.  The UE may be configured to measure and report, subject to UE capability, up to 8 DL PRS RSRP measurements on different DL PRS resources ~~from the same cell~~ associated with the same *TRP-ID-r16*. When the UE reports DL PRS RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS RSRP measurements have been performed using the same spatial domain filter for reception.  The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements corresponding to a single configured SRS resource or resource set for positioning. Each measurement corresponds to a single received DL PRS resource or resource set which can be in different positioning frequency layers.  If the UE is configured with *dl-PRS-QCL-Info-r16*and the QCL relation is between two DL PRS resources, then the UE assumes those DL PRS resources are ~~from the same cell~~ associated with the same *TRP-ID-r16*. If *dl-PRS-QCL-Info-r16*is configured to the UE with ‘QCL-Type-D’ with a source DL-PRS-Resource then the *nr-DL-PRS-ResourceSetId-r16*and the *nr-DL-PRS-ResourceId-r16*of the source DL PRS resource are expected to be indicated to the UE.  **<omitted text>** |

TP 13-2

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| **In TS 38.214 Section 5.1.6.5 (CR R1-2001731)**  5.1.6.5 PRS reception procedure  **<omitted text>**  The UE expects that it will be configured with *dl-PRS-ID-r16* each of which is defined such that it is associated with multiple DL PRS resource sets from the same cell. The UE expects that one of these *dl-PRS-ID-r16* along with a *nr-DL-PRS-ResourceSetId-r16* and a *nr-DL-PRS-ResourceId-r16* can be used to uniquely identify a DL PRS resource.  **<omitted text>**  A DL PRS resource is defined by:  **<omitted text>**  *- dl-PRS-ResourceSlotOffset-r16*determines the starting slot of the DL PRS resource with respect to corresponding DL PRS resource set slot offset  *- dl-PRS-ResourceSymbolOffset-r16* determines the starting symbol of the DL PRS resource within the starting slot.  *- dl-PRS-NumSymbols-r16*defines the number of symbols of the DL PRS resource within a slot where the allowable values are given in Clause 7.4.1.7.1 of [4, TS38.211].  *- dl-PRS-QCL-Info-r16*defines any quasi-colocation information of the DL PRS resource with other reference signals. The DL PRS may be configured to be ‘QCL-Type-D’ with a DL PRS or SS/PBCH Block from a serving cell or a non-serving cell. The DL PRS may be configured to be ‘QCL-Type-C’ with a SS/PBCH Block from a serving or non-serving cell. If the DL PRS is configured as both ‘QCL-Type-C’ and ‘QCL-Type-D’ with a SS/PBCH Block then the SSB index indicated should be the same.  The UE assumes constant EPRE is used for all REs of a given DL PRS resource.  The UE may be indicated by the network that a DL PRS resources can be used as the reference for the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo-r16*. The reference indicated by the network to the UE can also be used by the UE to determine how to apply higher layer parameters *nr-DL-PRS-expectedRSTD-r16*and *nr-DL-PRS-expectedRSTD-uncerainty-r16*. The UE expects the reference to be indicated whenever it is expected to receive the DL PRS. This reference provided by *nr-DL-PRS-ReferenceInfo-r16*may include an *dl-PRS-ID-r16*, a DL PRS resource set ID, and optionally a single DL PRS resource ID or a list of DL PRS resource IDs. The UE may use different DL PRS resources as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met or a different DL PRS resource set to determine the reference for the RSTD measurement ~~as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met~~. If the UE chooses to use a different reference than indicated by the network, then it is expected to report the *dl-PRS-ID-r16*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference.  **<omitted text>**  The UE may be configured to measure and report, subject to UE capability, up to 4 DL RSTD measurements per pair of cells with each measurement between a different pair of DL PRS resources or DL PRS resource sets within the DL PRS configured for those cells. The up to 4 measurements being performed on the same pair of cells and all DL RSTD measurements in the same report use a single reference timing.  The UE may be configured to measure and report, subject to UE capability, up to 8 DL PRS RSRP measurements on different DL PRS resources from the same cell. When the UE reports DL PRS RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS RSRP measurements have been performed using the same spatial domain filter for reception.  The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements corresponding to a single configured SRS resource or resource set for positioning. Each measurement corresponds to a single received DL PRS resource or resource set which can be in different positioning frequency layers.  If the UE is configured with *dl-PRS-QCL-Info-r16*and the QCL relation is between two DL PRS resources, then the UE assumes those DL PRS resources are from the same cell. If *dl-PRS-QCL-Info-r16*is configured to the UE with ‘QCL-Type-D’ with a source DL-PRS-Resource then the *nr-DL-PRS-ResourceSetId-r16*and the *nr-DL-PRS-ResourceId-r16*of the source DL PRS resource are expected to be indicated to the UE.  **<omitted text>** |

Feature lead response:

* Regarding ID, our understanding that *dl-PRS-ID-r16* is a correct implementation and we do not see the need to change
* Regarding “starting slot” it seems clear that it is a starting slot of DL PRS resource. It seems it is not essential correction.

### Companies comments

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| --- | --- |
| Company | Comment |
| Huawei/HiSIlicon | For starting slot, suggest to merge into 4.3.  TRP-ID should be changed to dl-PRS-ID.  To us, we prefer to break the entire jumbo TP to different issues as does to 4.1 – 4.5. Some of them should even be discussed in procedure agenda. |
| CATT | Support TP 13. |
| OPPO | Support TP 13 (13-1, 13-2).  Regarding the TRP ID, *dl-PRS-ID-r16* is optional, and it may not be configured. In TS 37.355, *TRP-ID-r16* is used. Thus *TRP-ID-r16* should be used in TP 13  TRP-ID-r16 ::= SEQUENCE {  dl-PRS-ID-r16 INTEGER (0..255) OPTIONAL,  nr-PhysCellId-r16 NR-PhysCellId-r16 OPTIONAL,  nr-CellGlobalId-r16 NCGI-r15 OPTIONAL, -- Need ON  nrARFCNRef-r16 ARFCN-ValueNR-r15 OPTIONAL, -- Cond NotSameAsRefServ0  ...  }  NR-DL-PRS-AssistanceDataPerTRP-r16 ::= SEQUENCE {  trp-ID-r16 TRP-ID-r16,  nr-DL-PRS-expectedRSTD-r16 INTEGER (-3841..3841),  nr-DL-PRS-expectedRSTD-uncerainty-r16 INTEGER (-246..246),  nr-DL-PRS-Config-r16 NR-DL-PRS-Config-r16,  For the part regarding “starting slot”, it should be merged into 4.3 as suggested by Huawei.  We also split the TP 13 into TP 13-1 and TP 13-2 to facilitate the discussion. |
| vivo | Our understanding is that the TRP-ID discussion in RAN2 has not fully settled in “[Post109bis-e][947][POS] TRP-ID structure”. With that, we prefer not to modify RAN1 specification for now and wait for RAN2’s update to align parameter IE name in the future.  On the changes in TP 13-2, first of all, as we commented in previous RAN1 meetings, we don’t see any issue in current description. Furthermore, what is the issue being corrected by moving around words as in “The UE may use different DL PRS resources as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met or a different DL PRS resource set to determine the reference for the RSTD measurement ~~as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met~~.”? Seems none.  So no support to TP 13, TP 13-1 or TP 13-2. |
| Nokia/NSB | Agree with vivo. |
| Qualcomm | Same view with vivo. Lets wait for the discussion to settle. |
| LG | Same view with vivo. |
| Intel | Regarding ID, our understanding that *dl-PRS-ID-r16* is a correct implementation and we do not see the need to change  Regarding “starting slot” it seems clear that it is a starting slot of DL PRS resource. It seems it is not essential correction.  OK to wait finalization of discussion in RAN2. |
| Sony | No need to change as of now. |

### Conclusions

Based on the comments there is no majority support for these TPs.

**Proposal for offline consensus:TP 13, 13-1 and 13-2 are not endorsed.**

UL SRS corrections

The following TPs are corrections to 38.211, 38.213 and 38.214, respectively.

* **for 38.214**
  + **The TPs in R1-2004644 (TP#1) R1-2003522 (part A, Part B T1)**
  + **Change “associated SRS resources set” to “SRS resources set to which the SRS resource belongs”, according to TP in proposal 4 of R1-2003407**
* **For 38.211: Remove the redundant description on SRS-PosResourceSet-r16 from Section 6.4.1.4.4 of TS 38.211, according to TP in proposal 1 of R1-2004053**
* **For 38.213, the TPs in R1-2004644 (TP#1), and TP corresponding to proposal 2,3,4 in R1-2004053**

## Editorial issue for 38. 211 SRS slot configuration

### Proposal

In [7] the following proposal is given with an associated TP reproduced below as TP 4

1. Remove the redundant description on SRS-PosResourceSet-r16 from Section 6.4.1.4.4 of TS 38.211

TP 14

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| **In TS 38.211 Section 6.4.1.4.4**  **CR R1-2003163**  *<omitted text>*  6.4.1.4.4 Sounding reference signal slot configuration  For an SRS resource configured as periodic or semi-persistent by the higher-layer parameter *resourceType*, a periodicity  (in slots) and slot offset  are configured according to the higher-layer parameter *periodicityAndOffset-p* or *periodicityAndOffset-sp* in the *SRS-Resource* IE ~~or the~~ *~~SRS-PosResource-r16~~* ~~IE~~, or *periodicityAndOffset-p-r16* or *periodicityAndOffset-sp-r16* in the *SRS-PosResource-r16* IE. Candidate slots in which the configured SRS resource may be used for SRS transmission are the slots satisfying    SRS is transmitted as described in clause 11.1 of [5, TS 38.213].  *<omitted text>* |

### Companies comments

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| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support TP 14 |
| ZTE | Support the TP. |
| CATT | Support TP 14. |
| OPPO | Support TP 14 |
| vivo | Okay with TP 14 |
| Qualcomm | OK |
| Samsung | OK |
| CMCC | We support the TP. |
| LG | Support |
| Intel | OK |
| Sony | Support the TP |

### Conclusions

Based on the latest comments, it seems that TP14 is agreeable and we propose the following offline consensus

**Proposal for offline consensus 11: Text proposal TP14 is endorsed**

## Editorial issues for 38.213 for uplink

### Proposals

The following TPs 5-8 and proposals have been proposed in [7][11] regarding parameter name alignment.

1. Align the following RRC parameters in TS 38.213 with those in TS 38.331

SRS-Positioning-Config -> SRS-PosResourceSet-r16

TP 15

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| **In TS 38.213 Section 7**   1. Uplink Power control   Uplink power control determines a power for PUSCH, PUCCH, SRS, and PRACH transmissions.  A UE does not expect to simultaneously maintain more than four pathloss estimates per serving cell for all PUSCH/PUCCH/SRS transmissions as described in Clauses 7.1.1, 7.2.1, and 7.3.1, except for SRS transmissions configured by IE *~~SRS-Positioning-Config~~ SRS-PosResourceSet-r16* as described in Clause 7.3.1.  A PUSCH/PUCCH/SRS/PRACH transmission occasion  is defined by a slot index  within a frame with system frame number , a first symbol  within the slot, and a number of consecutive symbols .  *<omitted text>* |

1. Use SRS-ResourceSet and SRS-PosResourceSet-r16 to differentiate the traditional SRS and SRS for positioning

TP 16

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| **In TS 38.213 Section 7** 7.3.1 UE behaviour If a UE transmits SRS based on a configuration by IE *~~SRS-Config~~ SRS-ResourceSet* on active UL BWP  of carrier  of serving cell  using SRS power control adjustment state with index , the UE determines the SRS transmission power  in SRS transmission occasion  as  [dBm]  *<omitted text>* |

TP 17

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| **In TS 38.213 Section 7**  Section 7.3.1 UE behaviour  *<omitted text>*  If a UE transmits SRS based on a configuration by IE *~~SRS-Positioning-Config~~ SRS-PosResourceSet-r16* on active UL BWP of carrier of serving cell , the UE determines the SRS transmission power in SRS transmission occasion as  [dBm]  where,  - and are provided by *p0-r16* and *alpha-r16* respectively, for active UL BWP of carrier of serving cell , and SRS resource set is indicated by *SRS-PosResourceSetId-r16* from *SRS-PosResourceSet-r16*, and  - is a downlink pathloss estimate in dB calculated by the UE, as described in Clause 7.1.1 in case of an active DL BWP of a serving cell , using RS resource indexed in a serving or non-serving cell for SRS resource set [6, TS 38.214]. A configuration for RS resource index associated with SRS resource set is provided by *pathlossReferenceRS-Pos-r16*  - if a *ssb-IndexNcell-r16* is provided, *referenceSignalPower* is provided by *ss-PBCH-BlockPower-r16*  - if a *dl-PRS-ResourceId-r16* is provided, *referenceSignalPower* is provided by *dl-PRS-ResourcePower-r16*  *<omitted text>* |

TP 18

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| Uplink Power control Uplink power control determines a power for PUSCH, PUCCH, SRS, and PRACH transmissions.  A UE does not expect to simultaneously maintain more than four pathloss estimates per serving cell for all PUSCH/PUCCH/SRS transmissions as described in Clauses 7.1.1, 7.2.1, and 7.3.1, except for SRS transmissions configured by *SRS-PosResourceSet-r16* ~~IE~~ *~~SRS-Positioning-Config~~* as described in Clause 7.3.1.  \*\*\* Unchanged text is omitted \*\*\*  7.3.1 UE behaviour  \*\*\* Unchanged text is omitted \*\*\*  If a UE transmits SRS based on a configuration ~~by IE~~ *~~SRS-Positioning-Config~~* provided by *SRS-PosResourceSet-r16* on active UL BWP of carrier of serving cell , the UE determines the SRS transmission power in SRS transmission occasion as  [dBm]  \*\*\* Unchanged text is omitted \*\*\* |

Additionally, in [7] a correction to the power control formula is proposed:

1. Correct the variables for the formula of power control for SRS for positioning

TP 19

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| **In TS 38.213**  Section 7.3.1 UE behaviour  *<omitted text>*  If a UE transmits SRS based on a configuration by IE *SRS-Positioning-Config* on active UL BWP of carrier of serving cell , the UE determines the SRS transmission power in SRS transmission occasion as  [dBm]  where,  - and are provided by *p0-r16* and *alpha-r16* respectively, for active UL BWP of carrier of serving cell , and SRS resource set is indicated by *SRS-PosResourceSetId-r16* from *SRS-PosResourceSet-r16*, and  - is a downlink pathloss estimate in dB calculated by the UE, as described in Clause 7.1.1 in case of an active DL BWP of a serving cell , using RS resource indexed in a serving or non-serving cell for SRS resource set [6, TS 38.214]. A configuration for RS resource index associated with SRS resource set is provided by *pathlossReferenceRS-Pos-r16*  - if a *ssb-IndexNcell-r16* is provided, *referenceSignalPower* is provided by *ss-PBCH-BlockPower-r16*  - if a *dl-PRS-ResourceId-r16* is provided, *referenceSignalPower* is provided by *dl-PRS-ResourcePower-r16*  If the UE determines that the UE is not able to accurately measure , or the UE is not provided with *pathlossReferenceRS-Pos-r16*, the UE calculates using a RS resource obtained from the SS/PBCH block of the serving cell that the UE uses to obtain *MIB*  The UE indicates a capability for a number of pathloss estimates that the UE can simultaneously maintain for all SRS resource sets provided by *SRS-PosResourceSet-r16* in addition to the up to four pathloss estimates that the UE maintains per serving cell for PUSCH/PUCCH/SRS transmissions.  *<omitted text>* |

Companies are encouraged to give their view on the TPs and proposals below.

### Companies comments

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| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | We agree with all TPs with the suggestion that either remove the word “IE” or use the word “IE” everywhere before *SRS-ResourceSet* or *SRS-PosResourceSet-r16* |
| ZTE | We also fine with all TPs. |
| CATT | Support TP 15~TP 19. |
| OPPO | Support TP 15-19 |
| vivo | Okay with TP 15-19 |
| Nokia/NSB | Support the TPs. |
| Samsung | Support |
| CMCC | We support all the TPs. |
| LG | Support TP 15-19. |
| Intel | OK. Agree w/ Huawei comment that notations should be consistent. |

### Conclusions

Based on the latest comments, it seems that TP15-19 are agreeable, with the removal of the “IE” before each IE name if present and we propose the following offline consensus

**Proposal for offline consensus 12: Text proposal TP15-19 are endorsed, with the word “IE” removed before each IE name if present.**

## Editorial issues for 38.214 for uplink

### Proposals

#### Clarification of associated resource sets

In [1] it is proposed to clarify the meaning of “associated resource set”

***Proposal 3:***

* ***Change “*associated SRS resources set*” to “*SRS resources set to which the SRS resource belongs*”.***

***Proposal 4:***

* ***Adopt the following text proposal into TS 38.214.***

TP 20

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| *TS 38.214-g10*  *6.2.1 UE sounding procedure*  < Unchanged parts are omitted >  The UE is not expected to be configured with different time domain ehaviour for SRS resources in the same SRS resource set. The UE is also not expected to be configured with different time domain ehaviour between SRS resource and ~~associated~~ SRS resource~~s~~ set to which the SRS resource belongs.  < Unchanged parts are omitted > |

#### Parameter name alignment in 38.214

In [3], a TP corresponding to the following correction is proposed:

* Replacing [SRS-for-positioning] with *SRS-PosResourceSet-r16* or *SRS-PosResource-r16* whichever applicable.
* Text change to reflect that spatial relation RS for *SRS-PosResource-r16* isprovided with *spatialRelationInfoPos-r16* IE and not *spatialRelationInfo* IE.
* Text change to reflect that *SRS-PosResource-r16* ID is provided with *SRS-PosResourceId-r16* and not *SRS-ResourceId.*
* Text change to reflect that SSB index in *spatialRelationInfoPos-r16* IE is provided with ‘ssb-IndexServing-r16’ or ‘ssb-IndexNcell-r16’ and not ‘ssb-Index’.
* Text change to reflect that CSI-RS index in *spatialRelationInfoPos-r16* IE is provided with ‘csi-RS-IndexServing-r16’and not ‘csi-RS-Index’.
* Text change to reflect that SRS in *spatialRelationInfoPos-r16* IE is provided with ‘srs-SpatialRelation-r16’ and not ‘srs’.
* Changing *DL-PRS-ResourceId* and *SRS-PosResource* respectively to *DL-PRS-ResourceId-r16* and *SRS-PosResource-r16* to unify the IE names across all RAN1 specifications.
* Changing *srs-Resource* and *srs-PosResource-r16* to *SRS-Resource* and *SRS-PosResource-r16*, respectively.
* Changing fonts of some Ies from normal to *italic*.
* Clarification regarding the configuration of the number of SRS resource for positioning.

TP 21

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| **<Unchanged part omitted>** 6.2 UE reference signal (RS) procedure6.2.1 UE sounding procedure The UE may be configured with one or more Sounding Reference Signal (SRS) resource sets as configured by the higher layer parameter *SRS-ResourceSet* or *SRS-PosResourceSet-r16*. For each SRS resource set configured by *SRS-ResourceSet*, a UE may be configured with SRS resources (higher layer parameter *SRS-Resource*), where the maximum value of K is indicated by UE capability[13, 38.306]. When SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16,* a UE may be configured with SRS resources (higher layer parameter *SRS-PosResource-r16*), where the maximum value of K is 16. The SRS resource set applicability is configured by the higher layer parameter *usage* in *SRS-ResourceSet.* When the higher layer parameter *usage* is set to ‘beamManagement’*,* only one SRS resource in each of multiple SRS sets may be transmitted at a given time instant, but the SRS resources in different SRS resource sets with the same time domain behaviour in the same BWP may be transmitted simultaneously.  For aperiodic SRS at least one state of the DCI field is used to select at least one out of the configured SRS resource set(s).  The following SRS parameters are semi-statically configurable by higher layer parameter *SRS-Resource or SRS-PosResource-r16*.  - *srs-ResourceId or srs-PosResourceId-r16* determines SRS resource configuration identity.  - Number of SRS ports as defined by the higher layer parameter *nrofSRS-Ports* and described in Clause 6.4.1.4 of [4, TS 38.211]. If not configured, *nrofSRS-Ports* is 1.  *-* Time domain behaviour of SRS resource configuration as indicated by the higher layer parameter *resourceType*, which may be periodic, semi-persistent, aperiodic SRS transmission as defined in Clause 6.4.1.4 of [4, TS 38.211].  - Slot level periodicity and slot level offset as defined by the higher layer parameters *periodicityAndOffset-p* or *periodicityAndOffset-sp* for an SRS resource of type periodic or semi-persistent. The UE is not expected to be configured with SRS resources in the same SRS resource set *SRS-ResourceSet* or *SRS-PosResourceSet-r16* with different slot level periodicities. For an *SRS-ResourceSet* configured with higher layer parameter *resourceType* set to ‘aperiodic’, a slot level offset is defined by the higher layer parameter *slotOffset.* For an *SRS-PosResourceSet-r16* with higher layer parameter *resourceType* set to ‘aperiodic’, the slot level offset is defined by the higher layer parameter *slotOffset* for eachSRS resource.  **<Unchanged part omitted>**  - The configuration of the spatial relation between a reference RS and the target SRS, where the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16*, if configured, contains the ID of the reference RS. The reference RS may be an SS/PBCH block, CSI-RS configured on serving cell indicated by higher layer parameter *servingCellId* if present, same serving cell as the target SRS otherwise, or an SRS configured on uplink BWP indicated by the higher layer parameter *uplinkBWP*, and serving cell indicated by the higher layer parameter *servingCellId* if present, same serving cell as the target SRS otherwise. When SRS is configured by the higher layer parameter *SRS-PosResourceSet-r16* the reference RS may also be a DL PRS configured on a serving cell, an SS/PBCH block or a DL PRS of a non-serving cell indicated by a higher layer parameter.  The UE may be configured by the higher layer parameter *resourceMapping* in *SRS-Resource* with an SRS resource occupying  adjacent symbols within the last 6 symbols of the slot, where all antenna ports of the SRS resources are mapped to each symbol of the resource. When the SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16,* the higher layer parameter *resourceMapping* in *SRS-PosResource-r16* indicates adjacent symbols anywhere within the slot.  **<Unchanged part omitted>**  For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource-r16* is set to ‘periodic’:  - if the UE is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* containing the ID of a reference‘ssb-Index’, ‘ssb-IndexServing-r16’, or ‘ssb-IndexNcell-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference ‘csi-RS-Index’ or ‘csi-RS-IndexServing-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* containing the ID of a reference ‘srs’ or ‘srs-SpatialRelation-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS. When the SRS is configured by the higher layer parameter *SRS-PosResource-r16* and if the higher layer parameter *spatialRelationInfoPos-r16* contains the ID of a reference ‘dl-PRS-ResourceId-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference DL PRS.  For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource-r16* is set to ‘semi-persistent’:  - **<Unchanged part omitted>**  - if an SRS resource in the activated resource set is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16*, the UE shall assume that the ID of the reference signal in the activation command overrides the one configured in *spatialRelationInfo or spatialRelationInfoPos-r16.*  - when a UE receives a deactivation command [10, TS 38.321] for an activated SRS resource set, and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the deactivation command, the corresponding actions in [10, TS 38.321] and UE assumption on cessation of SRS transmission corresponding to the deactivated SRS resource set shall apply starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH.  - if the UE is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* containing the ID of a reference ‘ssb-Index’, ‘ssb-IndexServing-r16’, or ‘ssb-IndexNcell-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference ‘csi-RS-Index’ or ‘csi-RS-IndexServing-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference ‘srs’ or ‘srs-SpatialRelation-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS or of the reference semi-persistent SRS. When the SRS is configured by the higher layer parameter *SRS-PosResourceSet* and if the higher layer parameter *spatialRelationInfoPos-r16* contains the ID of a reference ‘dl-PRS-ResourceId-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference DL PRS.  If the UE has an active semi-persistent SRS resource configuration and has not received a deactivation command, the semi-persistent SRS configuration is considered to be active in the UL BWP which is active, otherwise it is considered suspended.  For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter resourceType in *SRS-Resource* or *SRS-PosResource-r16* is set to ‘aperiodic’:  **<Unchanged part omitted>**  - If the UE receives the DCI triggering aperiodic SRS in slot *n* and except when SRS is configured with the higher layer parameter *SRS-PosResource-r16*, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in slot , if UE is configured with *CA-slot-offset* for at least one of the triggered and triggering cell, *Ks* =, otherwise, and where  *- k* is configured via higher layer parameter *slotOffset* for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively;  - and are the and the, respectively, which are determined by higher-layer configured *CA-slot-offset* for the cell receiving the PDCCH, and are the  and the , respectively, which are determined by higher-layer configured *CA-slot-offset* for the cell transmitting the SRS, as defined in [4, TS 38.211] clause 4.5.  - If the UE receives the DCI triggering aperiodic SRS in slot *n* and when SRS is configured with the higher layer parameter *SRS-PosResource-r16*, the UE transmits every aperiodic SRS resource in each of the triggered SRS resource set(s) in slot  where  *- k* is configured via higher layer parameter *slotOffset* for each aperiodic SRS resource in each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively;  - and the  for the {scheduling, scheduled} carrier pair is defined in [4, TS 38.211] clause 4.5.  - if the UE is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* containing the ID of a reference ‘ssb-Index’, ‘ssb-IndexServing-r16’, or ‘ssb-IndexNcell-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference ‘csi-RS-Index’ or ‘csi-RS-IndexServing-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, or of the latest reference aperiodic CSI-RS. If the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference ‘srs’ or ‘srs-SpatialRelation-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS or of the reference semi-persistent SRS or of the reference aperiodic SRS. When the SRS is configured by the higher layer parameter *SRS-PosResourceSet-r16* and if the higher layer parameter *spatialRelationInfoPos-r16* contains the ID of a reference dl-PRS-ResourceId-r16, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference DL PRS.  **<Unchanged part omitted>**  The UE is not expected to be configured with different time domain behaviour for SRS resources in the same SRS resource set. The UE is also not expected to be configured with different time domain behaviour between SRS resource and associated SRS resources set.  For operation in the same carrier, the UE is not expected to be configured on overlapping symbols with a SRS resource configured by the higher layer parameter *SRS-PosResource-r16* and a SRS resource configured by the higher layer parameter *SRS-Resource* with *resourceType* of both SRS resources as ‘periodic’.  For operation in the same carrier, the UE is not expected to be triggered to transmit SRS on overlapping symbols with a SRS resource configured by the higher layer parameter *SRS-PosResource-r16* and a SRS resource configured by the higher layer parameter *SRS-Resource* with *resourceType* of both SRS resources as ‘semi-persistent’ or ‘aperiodic’.  For single carrier operations, the UE does not expect to be configured on overlapping symbols with more than one SRS resources configured by the higher layer parameter *SRS-PosResource-r16* with *resourceType* of the SRS resources as ‘periodic’.  For single carrier operations, the UE does not expect to be triggered to transmit SRS on overlapping symbols with more than one SRS resources configured by the higher layer parameter *SRS-PosResource-r16* with *resourceType* of the SRS resources as ‘semi-persistent’ or ‘aperiodic’.  For intra-band and inter-band CA operations, a UE can simultaneously transmit more than one SRS resources configured by *SRS-PosResource-r16* on different CCs, subject to UE’s capability provided by [XX] and [YY] respectively.  **<Unchanged part omitted>**  When the higher layer parameter enableDefaultBeamPlForSRS is set ‘enabled’, and if the higher layer parameter spatialRelationInfo for the SRS resource, except for the SRS resource with the higher layer parameter usage in SRS-ResourceSet set to ‘beamManagement’ or for the SRS resource with the higher layer parameter usage in SRS-ResourceSet set to ‘nonCodebook’ with configuration of associatedCSI-RS or for the SRS resource configured by the higher layer parameter *SRS-PosResourceSet-r16*, is not configured in FR2 and if the UE is not configured with higher layer parameter(s) pathlossReferenceRS, the UE shall transmit the target SRS resource  **<Unchanged part omitted>**  **6.2.1.4 UE sounding procedure for positioning purposes**  When the SRS is configured by the higher layer parameter *SRS-PosResource-r16* and if the higher layer parameter *spatialRelationInfoPos-r16* is configured, it contains the ID of the configuration fields of a reference RS according to Clause 6.3.2 of [TS 38.331]. The reference RS can be an SRS configured by the higher layer parameter *SRS-Resource* or *SRS-PosResource-r16*, CSI-RS, SS/PBCH block, or a DL PRS configured on a serving cell or a SS/PBCH block or a DL PRS configured on a non-serving cell.  The UE is not expected to transmit multiple SRS resources with different spatial relations in the same OFDM symbol.  If the UE is not configured with the higher layer parameter spatialRelationInfoPos-r16 the UE may use a fixed spatial domain transmission filter for transmissions of the SRS configured by the higher layer parameter *SRS-PosResource-r16* across multiple SRS resources or it may use a different spatial domain transmission filter across multiple SRS resources.  The UE is only expected to transmit an SRS configured the by the higher layer parameter *SRS-PosResource-r16* within the active UL BWP of the UE.  When the configuration of SRS is done by the higher layer parameter *SRS-PosResource-r16*, the UE can only be provided with a single RS source in spatialRelationInfoPos-r16 per SRS resource for positioning.  **<Unchanged part omitted>** |

Companies are encouraged to give their view on the TPs below.

### Companies comments

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support TP 21.  TP 20 is not needed. We prefer not to change a text from Rel-15 unless it causes confusion. This is not the case here. |
| CATT | Support TP 20 and TP 21. |
| OPPO | Support TP 21  Not support TP20 |
| vivo | Support TP 20 as the word ‘associated’ in multiple places of 38.214 may lead to broader interpretation than the intended SRS resource belonging to a SRS resource set in this particular case.  We’re fine with IE name alignment in general for TP 21. However, we don’t see the need to reword existing descriptions as in TP 21.  1. Why changing into “When SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16,* a UE may be configured with SRS resources (higher layer parameter *SRS-PosResource-r16*), where the maximum value of K is 16. ” is necessary? We can simply just modify the IE name as in “except when SRS is configured with the higher layer parameter ~~[SRS-for-positioning]~~*SRS-PosResourceSet-r16* in which case the maximum value of K is 16.”  2. Again, why change into “*.* For an *SRS-PosResourceSet-r16* with higher layer parameter *resourceType* set to ‘aperiodic’,”? Prefer just “except when SRS is configured with the higher layer parameter ~~[SRS-for-positioning]~~*SRS-PosResourceSet-r16* in which case”.  3. About changes spatial relationship information, as we commented in section 3.1 toward TP 2. We think it is necessary to change ’DL-PRS-ResourceId’ into ’dl-PRS-r16’.  So not agree to TP 21 as it is. |
| Nokia/NSB | We are only okay with the IE name alignment which we suggest either be handled as an independent TP or with direct contact with the editor. TP 21 has changes which are not simple IE alignments as commented by vivo and therefore we don’t support it.  We don’t support TP 20. |
| Huawei/HiSilicon2 | **Answer to Vivo:**  **Regarding issue 1:** Again, we understand and in principle agree with the intention of minimalistic change. However, if we go with Vivo’s suggestion, the relevant part of the TP would be as follows:  “For each SRS resource set, a UE may be configured with SRS resources (higher layer parameter *SRS-Resource*), where the maximum value of K is indicated by UE capability[13, 38.306] except when SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16,* in which case the maximum value of K is 16.”  Above text is technically not correct and interpretable in a wrong way. One problem is the text inside parentheses **“(**higher layer parameter *SRS-Resource*)” which implies that all SRS resources are configured by *SRS-Resource.* Note that it does not say “SRS Resources that are configured by higher layer parameter *SRS-Resource*” in which case it would have been OK. Then it goes on to makes an **exception** to the rule for particular SRSs that are configured by *SRS-PosResourceSet-r16.* The way that above text is written, implies that among all SRSs configured by *SRS-Resource* there is a subset of SRSs that are further configured with *SRS-PosResource-r16*, which is obviously not correct.  Therefore, we think that our proposed change is clearer and not interpretable.  **Regarding issue 2:** Similar reason as above.If we go with Vivo’s suggestion, the relevant part of the TP would be as follows:  “For an *SRS-ResourceSet* configured with higher layer parameter *resourceType* set to ‘aperiodic’, a slot level offset is defined by the higher layer parameter *slotOffset* except when SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16* in which case the slot level offset is defined by the higher layer parameter *slotOffset* for eachSRS resource.”  Above text simply says that the slot offset is per set for all SRS resources configured by *SRS-ResourceSet* then makes an **exception** for SRS resources configured *SRS-PosResourceSet-r16*. This exception would have made sense only if SRS resources configured by *SRS-PosResourceSet-r16* are subset of SRS resources configured by *SRS-ResourceSet.* This is obviously not true and *SRS-PosResourceSet-r16* and *SRS-ResourceSet* are independent and both under *SRS-Config.*  Therefore, we think that our proposed change is necessary to avoid such confusion. |
| Qualcomm | We are OK with the IE alignment changes in TP 21. TP 20 is not needed. |
| Samsung | OK with TP 20 and 21. |
| CMCC | We support TP21. |
| Vivo2 | Response to Huawei/HiSilicon2.  I’m not a native English speaker. However, I totally don’t understand how the word ‘except’ can be interpreted as subset relationship. |
| LG | We are generally fine with TP 21, but please check some typos in the middle of TP 21 such as “42ehaviour”, which is captured below  “The UE is not expected to be configured with different time domain ehaviour for SRS resources in the same SRS resource set. The UE is also not expected to be configured with different time domain ehaviour between SRS resource and associated SRS resources set.” |
| Intel | Agree with Nokia. Suggest editor to make an alignment or just make an agreement on what needs to be aligned as we commented earlier. |
| Huawei/HiSilicon3 | **Answer to Nokia and Intel:**  We are hoping that our colleagues from Nokia and Intel specifically mention that what parts of the TP are not necessary/wrong and why. Both Nokia and Intel say that they only support IE name alignments in TP 21.   1. We are not very clear what exactly “IE name alignment” means to our colleagues in Nokia and Intel. Does it only mean:    1. to update the IE names from, for instance [SRS-for-positioning], to *SRS-PosResourceSet-r16,* or    2. Does it also include the IE/field name additions when necessary, for instance,       1. changing “spatialRelationInfo” to “spatialRelationInfo or spatialRelationInfoPos-r16” when necessary       2. Chaning “ssb-Index” to “’ssb-Index’, ‘ssb-IndexServing-r16’, or ‘ssb-IndexNcell-r16’” when necessary       3. Changing “‘csi-RS-Index’” to “‘csi-RS-Index’ or ‘csi-RS-IndexServing-r16’” when necessary       4. Changing “‘srs’” to “‘srs’ or ‘srs-SpatialRelation-r16’” when necessary.   If Nokia and Intel only agree with changes in 1.1, the direct consequence would be the presence of misleading and incorrect text in the specification since, for instance, the index of SSB in spatialRelationInfoPos-r16 is not ‘ssb-Index’ but is ssb-IndexServing-r16’, or ‘ssb-IndexNcell-r16’. Similar story also holds regarding CSI-RS index, SRS index, and so on. Please note that the changes in 1.2 cannot be simply left to the editor because, there are other occasions in Clause 6.2.1 in 38.214 that, for instance, “*spatialRelationInfo*” should remain as is and not changed to “*spatialRelationInfo* or *spatialRelationInfoPos-r16*” (Since there is no change, there are not included in this TP). Therefore, we believe that it is our job to agree on the TP and send it to the Editor.  If Nokia and Intel agree with both types of changes in 1.1 and 1.2, then except two occasions, all the TP is entirely based on changes of type 1.1 or 1.2. The two occasions wherein the changes cannot be categorized as 1.1 or 1.2, are, in our opinion, necessary editorials that avoid incorrect text. These two editorials were questioned by vivo and we have provided our answer to our colleague in Vivo in our earlier reply Huawei/HiSilicon2.  **Comment to Feature Lead:**  Somewhere during the Email discussion, the following typos are created in TP that need to be fixed:   * “ehavior” changed to “46ehaviour” as pointed out by LG. * “Proposal 17” is added at the beginning of a paragraph. |
| Nokia/NSB 2 | **To Huawei:**  In the first part of the TP which reads “For each SRS resource set configured by *SRS-ResourceSet*, a UE may be configured with SRS resources (higher layer parameter *SRS-Resource*), where the maximum value of K is indicated by UE capability[13, 38.306]. When SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16,* a UE may be configured with SRS resources (higher layer parameter *SRS-PosResource-r16*), where the maximum value of K is 16.”  This change is not simple IE alignment. We think it is not needed and would be much simpler to change the spec as follows:  “(higher layer parameter *SRS-Resource or SRS-PosResource-r16*)”  We also feel that the part of the TP which suggests “indicates adjacent symbols anywhere within the slot.” Is not needed.  The other changes are okay for us. |
| Huawei/HiSilicon4 | **To Nokia in Nokia/NSB 2:**  Thanks for your reply and agreeing with most of the changes in TP 21 except two specific concern.  **Regarding the first concern:**  We hate to be pedantic but, below, we bring the concerned part in TP 21 and the proposed alternative in Nokia/NSB 2. We still believe that the proposed text in TP 21 is much more readable and accurate with a limited editorial change and, we dare to say, has a better grammar. The text proposed by Nokia suggests that K is a UE capability for both cases of SRS configured by *SRS-Resource or SRS-PosResource-r16* and, then, right after,makes an exception and say that K =16 in the case when SRS is configured using *SRS-PosResource-r16.* We wonder why we should have this quite strange text in the specification when it can be easily fixed using the provided text in TP 21.  **Proposed by Nokia in Nokia/NSB 2:**   |  | | --- | | For each SRS resource set, a UE may be configured with SRS resources (higher layer parameter *SRS-Resource or SRS-PosResource-r16*), where the maximum value of K is indicated by UE capability[13, 38.306] except when SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16,* in which case the maximum value of K is 16. |   **Proposed in TP 21:**   |  | | --- | | For each SRS resource set configured by *SRS-ResourceSet*, a UE may be configured with SRS resources (higher layer parameter *SRS-Resource*), where the maximum value of K is indicated by UE capability[13, 38.306]. When SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16,* a UE may be configured with SRS resources (higher layer parameter *SRS-PosResource-r16*), where the maximum value of K is 16. |   **Regarding the Second concern:**  Again,we bring the concerned part in TP 21 and the proposed alternative in Nokia/NSB 2. We are optimistic that Nokia would agree with us that the sentence proposed by Nokia below does not have a verb and needs some modification. Such modification is in fact provided in TP 21.  **Proposed by Nokia in Nokia/NSB 2:**   |  | | --- | | When the SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16,* the higher layer parameter *resourceMapping* in *SRS-PosResource-r16* with an SRS resource occupying adjacent symbols anywhere within the slot. |   **Proposed in TP 21:**   |  | | --- | | When the SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16,* the higher layer parameter *resourceMapping* in *SRS-PosResource-r16* indicates adjacent symbols anywhere within the slot. | |
| Nokia/NSB 3 | **To Huawei:**  To the first concern above: Honestly, we don’t really see much difference between the two proposals and think our proposal is clear with smaller change to the current spec. However, if all other companies are okay with the Huawei proposed text we can live with it.  To the second concern above: Last I checked “occupying” counts as a verb 😊. The text we propose is the closest aligned to the sentence that appears before it in the spec (which has been there from Rel-15). We prefer to align with that text and just do the IE alignment as we propose. |
| Huawei/HiSilicon4 | **To Nokia/NSB 3:**  Thanks for the reply and being flexible about our first concern. Regarding the second concern, we still think our suggestion is clearer but we also trust Nokia’s judgement about this and can go with Nokia’s suggested wording. |
| Ericsson | we’re fine with the TP and proposed changes. we don’t want do delay convergence and are ok if Nokia and Huawei have agreed to a compromise regarding their changes. However regarding the changes proposed by Nokia, we think that if we want to keep the wording style used for SRS-resource in rel15, we also need to align the beginning of the sentence. Therefore we would prefer the proposal as Huawei had originally proposed. That being said, if the current understanding closes the issue we are fine. |
| Sony | We are fine with TP21 |

### Conclusions

Based on the comments TP 20 is not agreeable. TP21 can be endorsed with changes based on the comments by nokia regarding the section on *resourceMapping*. The following offline consensus is proposed:

**Proposal for offline consensus 13: The following TP (TP-21b) is agreed**

TP 21b

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| --- |
| **<Unchanged part omitted>** 6.2 UE reference signal (RS) procedure6.2.1 UE sounding procedure The UE may be configured with one or more Sounding Reference Signal (SRS) resource sets as configured by the higher layer parameter *SRS-ResourceSet* or *SRS-PosResourceSet-r16*. For each SRS resource set configured by *SRS-ResourceSet*, a UE may be configured with SRS resources (higher layer parameter *SRS-Resource*), where the maximum value of K is indicated by UE capability[13, 38.306]. When SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16,* a UE may be configured with SRS resources (higher layer parameter *SRS-PosResource-r16*), where the maximum value of K is 16. The SRS resource set applicability is configured by the higher layer parameter *usage* in *SRS-ResourceSet.* When the higher layer parameter *usage* is set to ‘beamManagement’*,* only one SRS resource in each of multiple SRS sets may be transmitted at a given time instant, but the SRS resources in different SRS resource sets with the same time domain behaviour in the same BWP may be transmitted simultaneously.  For aperiodic SRS at least one state of the DCI field is used to select at least one out of the configured SRS resource set(s).  The following SRS parameters are semi-statically configurable by higher layer parameter *SRS-Resource or SRS-PosResource-r16*.  - *srs-ResourceId or srs-PosResourceId-r16* determines SRS resource configuration identity.  - Number of SRS ports as defined by the higher layer parameter *nrofSRS-Ports* and described in Clause 6.4.1.4 of [4, TS 38.211]. If not configured, *nrofSRS-Ports* is 1.  *-* Time domain behaviour of SRS resource configuration as indicated by the higher layer parameter *resourceType*, which may be periodic, semi-persistent, aperiodic SRS transmission as defined in Clause 6.4.1.4 of [4, TS 38.211].  - Slot level periodicity and slot level offset as defined by the higher layer parameters *periodicityAndOffset-p* or *periodicityAndOffset-sp* for an SRS resource of type periodic or semi-persistent. The UE is not expected to be configured with SRS resources in the same SRS resource set *SRS-ResourceSet* or *SRS-PosResourceSet-r16* with different slot level periodicities. For an *SRS-ResourceSet* configured with higher layer parameter *resourceType* set to ‘aperiodic’, a slot level offset is defined by the higher layer parameter *slotOffset.* For an *SRS-PosResourceSet-r16* with higher layer parameter *resourceType* set to ‘aperiodic’, the slot level offset is defined by the higher layer parameter *slotOffset* for eachSRS resource.  **<Unchanged part omitted>**  - The configuration of the spatial relation between a reference RS and the target SRS, where the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16*, if configured, contains the ID of the reference RS. The reference RS may be an SS/PBCH block, CSI-RS configured on serving cell indicated by higher layer parameter *servingCellId* if present, same serving cell as the target SRS otherwise, or an SRS configured on uplink BWP indicated by the higher layer parameter *uplinkBWP*, and serving cell indicated by the higher layer parameter *servingCellId* if present, same serving cell as the target SRS otherwise. When SRS is configured by the higher layer parameter *SRS-PosResourceSet-r16* the reference RS may also be a DL PRS configured on a serving cell, an SS/PBCH block or a DL PRS of a non-serving cell indicated by a higher layer parameter.  The UE may be configured by the higher layer parameter *resourceMapping* in *SRS-Resource* with an SRS resource occupying  adjacent symbols within the last 6 symbols of the slot, where all antenna ports of the SRS resources are mapped to each symbol of the resource. When the SRS is configured with the higher layer parameter *SRS-PosResourceSet-r16,* the higher layer parameter *resourceMapping* in *SRS-PosResource-r16* with an SRS resource occupying adjacent symbols anywhere within the slot.  **<Unchanged part omitted>**  For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource-r16* is set to ‘periodic’:  - if the UE is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* containing the ID of a reference‘ssb-Index’, ‘ssb-IndexServing-r16’, or ‘ssb-IndexNcell-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference ‘csi-RS-Index’ or ‘csi-RS-IndexServing-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* containing the ID of a reference ‘srs’ or ‘srs-SpatialRelation-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS. When the SRS is configured by the higher layer parameter *SRS-PosResource-r16* and if the higher layer parameter *spatialRelationInfoPos-r16* contains the ID of a reference ‘dl-PRS-ResourceId-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference DL PRS.  For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource-r16* is set to ‘semi-persistent’:  - **<Unchanged part omitted>**  - if an SRS resource in the activated resource set is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16*, the UE shall assume that the ID of the reference signal in the activation command overrides the one configured in *spatialRelationInfo or spatialRelationInfoPos-r16.*  - when a UE receives a deactivation command [10, TS 38.321] for an activated SRS resource set, and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the deactivation command, the corresponding actions in [10, TS 38.321] and UE assumption on cessation of SRS transmission corresponding to the deactivated SRS resource set shall apply starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH.  - if the UE is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* containing the ID of a reference ‘ssb-Index’, ‘ssb-IndexServing-r16’, or ‘ssb-IndexNcell-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference ‘csi-RS-Index’ or ‘csi-RS-IndexServing-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference ‘srs’ or ‘srs-SpatialRelation-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS or of the reference semi-persistent SRS. When the SRS is configured by the higher layer parameter *SRS-PosResourceSet* and if the higher layer parameter *spatialRelationInfoPos-r16* contains the ID of a reference ‘dl-PRS-ResourceId-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference DL PRS.  If the UE has an active semi-persistent SRS resource configuration and has not received a deactivation command, the semi-persistent SRS configuration is considered to be active in the UL BWP which is active, otherwise it is considered suspended.  For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter resourceType in *SRS-Resource* or *SRS-PosResource-r16* is set to ‘aperiodic’:  **<Unchanged part omitted>**  - If the UE receives the DCI triggering aperiodic SRS in slot *n* and except when SRS is configured with the higher layer parameter *SRS-PosResource-r16*, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in slot , if UE is configured with *CA-slot-offset* for at least one of the triggered and triggering cell, *Ks* =, otherwise, and where  *- k* is configured via higher layer parameter *slotOffset* for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively;  - and are the and the, respectively, which are determined by higher-layer configured *CA-slot-offset* for the cell receiving the PDCCH, and are the  and the , respectively, which are determined by higher-layer configured *CA-slot-offset* for the cell transmitting the SRS, as defined in [4, TS 38.211] clause 4.5.  - If the UE receives the DCI triggering aperiodic SRS in slot *n* and when SRS is configured with the higher layer parameter *SRS-PosResource-r16*, the UE transmits every aperiodic SRS resource in each of the triggered SRS resource set(s) in slot  where  *- k* is configured via higher layer parameter *slotOffset* for each aperiodic SRS resource in each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively;  - and the  for the {scheduling, scheduled} carrier pair is defined in [4, TS 38.211] clause 4.5.  - if the UE is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* containing the ID of a reference ‘ssb-Index’, ‘ssb-IndexServing-r16’, or ‘ssb-IndexNcell-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference ‘csi-RS-Index’ or ‘csi-RS-IndexServing-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, or of the latest reference aperiodic CSI-RS. If the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference ‘srs’ or ‘srs-SpatialRelation-r16’, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS or of the reference semi-persistent SRS or of the reference aperiodic SRS. When the SRS is configured by the higher layer parameter *SRS-PosResourceSet-r16* and if the higher layer parameter *spatialRelationInfoPos-r16* contains the ID of a reference dl-PRS-ResourceId-r16, the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference DL PRS.  **<Unchanged part omitted>**  The UE is not expected to be configured with different time domain behaviour for SRS resources in the same SRS resource set. The UE is also not expected to be configured with different time domain behaviour between SRS resource and associated SRS resources set.  For operation in the same carrier, the UE is not expected to be configured on overlapping symbols with a SRS resource configured by the higher layer parameter *SRS-PosResource-r16* and a SRS resource configured by the higher layer parameter *SRS-Resource* with *resourceType* of both SRS resources as ‘periodic’.  For operation in the same carrier, the UE is not expected to be triggered to transmit SRS on overlapping symbols with a SRS resource configured by the higher layer parameter *SRS-PosResource-r16* and a SRS resource configured by the higher layer parameter *SRS-Resource* with *resourceType* of both SRS resources as ‘semi-persistent’ or ‘aperiodic’.  For single carrier operations, the UE does not expect to be configured on overlapping symbols with more than one SRS resources configured by the higher layer parameter *SRS-PosResource-r16* with *resourceType* of the SRS resources as ‘periodic’.  For single carrier operations, the UE does not expect to be triggered to transmit SRS on overlapping symbols with more than one SRS resources configured by the higher layer parameter *SRS-PosResource-r16* with *resourceType* of the SRS resources as ‘semi-persistent’ or ‘aperiodic’.  For intra-band and inter-band CA operations, a UE can simultaneously transmit more than one SRS resources configured by *SRS-PosResource-r16* on different CCs, subject to UE’s capability provided by [XX] and [YY] respectively.  **<Unchanged part omitted>**  When the higher layer parameter enableDefaultBeamPlForSRS is set ‘enabled’, and if the higher layer parameter spatialRelationInfo for the SRS resource, except for the SRS resource with the higher layer parameter usage in SRS-ResourceSet set to ‘beamManagement’ or for the SRS resource with the higher layer parameter usage in SRS-ResourceSet set to ‘nonCodebook’ with configuration of associatedCSI-RS or for the SRS resource configured by the higher layer parameter *SRS-PosResourceSet-r16*, is not configured in FR2 and if the UE is not configured with higher layer parameter(s) pathlossReferenceRS, the UE shall transmit the target SRS resource  **<Unchanged part omitted>**  **6.2.1.4 UE sounding procedure for positioning purposes**  When the SRS is configured by the higher layer parameter *SRS-PosResource-r16* and if the higher layer parameter *spatialRelationInfoPos-r16* is configured, it contains the ID of the configuration fields of a reference RS according to Clause 6.3.2 of [TS 38.331]. The reference RS can be an SRS configured by the higher layer parameter *SRS-Resource* or *SRS-PosResource-r16*, CSI-RS, SS/PBCH block, or a DL PRS configured on a serving cell or a SS/PBCH block or a DL PRS configured on a non-serving cell.  The UE is not expected to transmit multiple SRS resources with different spatial relations in the same OFDM symbol.  If the UE is not configured with the higher layer parameter spatialRelationInfoPos-r16 the UE may use a fixed spatial domain transmission filter for transmissions of the SRS configured by the higher layer parameter *SRS-PosResource-r16* across multiple SRS resources or it may use a different spatial domain transmission filter across multiple SRS resources.  The UE is only expected to transmit an SRS configured the by the higher layer parameter *SRS-PosResource-r16* within the active UL BWP of the UE.  When the configuration of SRS is done by the higher layer parameter *SRS-PosResource-r16*, the UE can only be provided with a single RS source in spatialRelationInfoPos-r16 per SRS resource for positioning.  **<Unchanged part omitted>** |

Companies are encouraged to comment on the proposal for offline consensus:

|  |  |
| --- | --- |
| Company | Comment |
| Sony | Support |
| Huawei/HiSilicon | Support |
|  |  |

# Conclusions

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