**3GPP TSG RAN WG1 Meeting #114 R1-230xxxx**

Toulouse, France, August 21 – 25, 2023

**Agenda item: 9.17**

**Source: Nokia, Nokia Shanghai Bell**

**Title: Summary on email discussion on** **NR Enhanced Positioning**

**Document for: Discussion and Decision**

# 1 Introduction

This thread will discuss the draft CR to 38.214 for the NR Enhanced Positioning.

First checkpoint for this discussion: **September 5, 6:00 UTC**!

# 2 Discussion – first round

The comments in this section are based on version 0 of the the draft CR available in the **Post RAN1#114 discussion.**

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| Company | Comments | Editor reply/Notes |
| Intel | * **Comment #1**

In subclause 5.1.6.5, the RSCP and RSCPD need to be swapped as indicated below:

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| When the UE reports DL RSCPD measurement(s) along with DL RSTD measurement(s) or DL RSCP measurement(s) along with UE Rx-Tx time difference measurement(s), the DL RSCPD and/or DL RSCP measurement(s) should be measured from a single DL PRS positioning frequency layer.  |

* **Comment #2**

In subclause 5.1.6.5, suggest that the following sentence be removed – as discussed as part of review of draft CR for 38.215, it can be captured in RAN4 specs.

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| The UE is not expected to obtain more than 1 DL RSCP or DL RSCPD measurement sample in a single measurement instance. |

* **Comment #3**

In subclause 5.1.6.5, for the following sentence, suggest to add “subject to UE capability” as per the agreement

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| When the UE reports a timestamp associated with a DL RSCP measurement or a DL RSCPD measurement, subject to UE capability, it may include a symbol index in the timestamp. |

* **Comment #4**

In subclause 6.2.1.4, For the following suggest couple of updates indicated below for improved readability.

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| The reduced capability UE transmit frequency hopping is configured within one SRS resource for positioning that may be configured with a bandwidth larger than the maximum bandwidth of the reduced capability UE, in RRC\_CONNECTED or RRC\_INACTIVE mode. The reduced capability UE transmit frequency hopping may be configured with overlapping or non-overlapping frequency hops in the frequency domain. When the reduced capability UE is configured to perform transmit frequency hopping it expects to be configured via [higher layer parameter] with the starting PRB of the first frequency hop. |

* **Comment #5**

Option 1 in the following agreement needs to be captured in Clause 6.2.1.4. **Agreement**With regard to aperiodic positioning SRS for bandwidth aggregation for UEs in RRC\_CONNECTED state, support both Option 2 and Option1.* Option 2: Support to use a DCI format 0\_3 or 1\_3 for multi-cell PDSCH/PUSCH scheduling to trigger SRS resources for bandwidth aggregation in multiple CCs.
* Option 1: Support a Rel-17 single DCI scheduling positioning SRS resource sets across the linked carriers, as a separate UE capability.
	+ Reuse Rel-17 DCI framework without modification.
	+ If a single DCI indicates transmission of an aperiodic positioning SRS resource set, UE transmits aperiodic positioning SRS resource sets across all linked carriers for bandwidth aggregation.
* **Comment #6**

Based on the agreement, if SRS in one of aggregated carriers is dropped in a symbol, UE will drop SRS transmission in other CCs. The following highlighted text may need to be updated as “if an SRS transmission in one of the CC is dropped” as it is not always the case that UE will drop SRS transmission (e.g., for A-SRS transmission for positioning) if SRS collides with other signals/channels.

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| For the linked SRS resource sets for bandwidth aggregation across CCs, if an SRS configured by the higher layer parameter SRS-PosResource collides with other signals or channels on a symbol, SRS transmission of the linked SRS resource sets across all CCs is dropped on that symbol. |

* **Comment #7**

In subclause 8.2.4.1.1, we suggest to remove “For comb sizes of 1, 2, 4” in the last bullet as there is no such restriction for TDM’ed multiplexing between PSSCH and SL PRS. Adding it would be redundant since only comb sizes of 1, 2, 4 are supported for SL PRS in shared resource pool. In addition, based on the following working assumption, SL PRS is transmitted in the last M consecutive symbols considering all other restrictions including PSFCH. Lastly, we also suggest to add a placeholder after “in parameter” in the first bullet similar to what is currently captured for dedicated resource pool.

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| - the UE shall transmit SL PRS only after the last symbol with second stage SCI .- For a given value of ‘M’, SL PRS resource is mapped to the last consecutive ‘M’ SL symbols in the slot that meet the other restrictions- For comb sizes of 1, 2, 4, the UE shall not transmit PSSCH and SL PRS in the same symbol.]For a shared resource pool, the UE shall not transmit SL PRS in symbols where PSFCH is transmitted. |

We suggest to update the above text as follows:

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| - the number of contiguous symbols for SL PRS transmission, ‘M’, shall correspond to one of the SL PRS resources in parameter [TODO]~~.~~- the UE shall not transmit SL PRS in symbols where associated PSCCH is transmitted- the UE shall not transmit SL PRS and PSSCH DMRS in the same symbol~~.~~- the UE shall transmit SL PRS only after the last symbol with second stage SCI~~.~~- the UE shall not transmit SL PRS in symbols where PSFCH is transmitted-~~- For comb sizes of 1, 2, 4,~~ the UE shall not transmit PSSCH and SL PRS in the same symbol- ~~F~~for a given value of ‘M’, SL PRS resource is mapped to the last consecutive ‘M’ SL symbols in the slot that meet the other restrictions.~~- - For comb sizes of 1, 2, 4, the UE shall not transmit PSSCH and SL PRS in the same symbol.]~~~~For a shared resource pool, the UE shall not transmit SL PRS in symbols where PSFCH is transmitted.~~ |

**Working assumption**For a shared resource pool,* Explicit (pre-)configuration of SL PRS resources in a slot, applicable for an indicated frequency domain allocation, includes:
	+ SL PRS Resource ID, (M, N) pattern, comb offset.
* For a given value of ‘M’, SL PRS resource is mapped to the last consecutive ‘M’ SL symbols in the slot that can be used for SL PRS, i.e., taking into consideration multiplexing with PSSCH DMRS, PT-RS, CSI-RS, PSFCH, gap symbols, AGC symbols, PSCCH in the slot
* The maximum number of SL PRS resources in a slot of a shared resource pool that can be (pre-)configured is FFS.
* **Comment #8**

It is not clear the meaning of “within parameter”. We suggest to add a placeholder for the higher layer parameter as done elsewhere “that is provided by [*higher-layer-parameter*]”.

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| The first SL PRS resource is determined according to the sub-channel used for the PSCCH transmission containing the associated SCI format 1-B: The index of the sub-channel in the resource pool is identical to the index of the SL PRS resource ~~within parameter~~ that is provided by [*higher-layer-parameter*]. |

* **Comment #9**

It appears that the following agreements are not captured in 211 or 214 and we think 214 would be the right place for these.

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| **Agreement**At least for dedicated SL PRS resource pools, in addition to already-agreed (M, N) = (2, 2), (4, 4), fully staggered pattern with (M, N) = (6, 6) is supported. * FFS: Other values of (M, N).
* FFS: Applicability to shared resource pools.

AgreementFor a dedicated resource pool, the maximum number of TDM groups for TDM-based multiplexing of SL PRS within a slot is 4.* Maximum number 4 only applies to the case of comb-2

AgreementFor SL PRS in a dedicated or shared resource pool, for a given valid comb size ‘N’, partially staggered SL PRS patterns (M, N) are supported for all integer values of ‘M’ such that (M, N) = (1, 2) or (2, 4). |

* **Comment #10**

In section 8.2.4.1.1, suggest the following modification, otherwise it looks inaccurate:* A UE does not transmit on multiple SL PRS resources in the same slot
* **Comment #11**

In section 8.2.4.1.1, there is a typo “asubject” -> “subject” which is visible when markups are switched off:* For a dedicated resource pool, UE shall transmit SL PRS ~~a~~subject to the following restrictions:
* **Comment #12**

In section 8.2.4.1.2, the second sentence is not completely accurate since there is no definition of FDRA of a resource pool. Suggest the following modification:For a dedicated resource pool, the frequency domain resource assignment of a SL PRS resource is same as frequency resources of a resource pool ~~the same as the resource pool~~ |  |
| ZTE | **Comment 1: for RedCap**For RedCap, PRS Rx hopping in RRC\_INACTIVE and RRC\_IDLE have been supported. The measurement gap is only applicable for RRC\_CONNECTED state.

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| AgreementPRS Rx frequency hopping for RRC\_INACTIVE state and for RRC\_IDLE state is supported for a RedCap UE. |

Here is our suggestion:---------------------------The reduced capability UE may be configured to measure and report, subject to UE capability, via [higher layer parameter] the DL RSTD, DL PRS-RSRP, DL PRS-RSRPP, or UE Rx-Tx time difference using receiver frequency hopping for a DL PRS resource, with bandwidth that may be greater than the maximum reduced capability UE bandwidth. The reduced capability UE performing receiver frequency hopping may be configured to report via [*higher layer parameter*] one measurement associated with one received frequency hop or one measurement based on multiple hops of the DL PRS. In RRC\_CONNECTED state, the reduced capability UE is expected to use a single instance of a configured measurement gap to receive all hops of the DL PRS using receiver frequency hopping. **Comment2: for CPP**RSCPD should be reported along with RSTD. Also, it should be either one of RSCP and RSCPD, rather than both of them.Here is our suggestion:---------------------------When the UE reports DL RSCPD measurement(s) along with DL RSTD measurement(s) or DL RSCP measurement(s) along with UE Rx-Tx time difference measurement(s), the DL RSCP or DL RSCPD measurement(s) should be measured from a single DL PRS positioning frequency layer.**Comment 3: for CPP**In Rel-17 specification, Nsample can be 1 or 2 as shown in 38.214 as follows.

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| Rel-17 38.214The UE may be requested, subject to UE capability, to measure and report one or more of the DL RSTD, DL PRS-RSRP, DL PRS-RSRPP, or UE Rx-Tx time difference measurements with either $N\_{sample}$ or 4 samples, where $N\_{sample}$ = 1 or 2 is as defined in [11, TS 38.133], via higher layer parameter *reducedDL-PRS-ProcessingSamples* [17, TS 37.355] which applies for all DL PRS positioning frequency layers. |

For CPP in Rel-18, Nsample can only be 1 as shown in the following agreement.

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| AgreementEach DL RSCP/RSCPD measurement instance is obtained with $N\_{sample}=1$ sample only. |

We think the similar wording should be used. Here is our suggestion:---------------------------The UE, subject to UE capability, may be requested via [higher layer parameter] to perform DL RSCP or DL RSCPD measurements on indicated DL PRS resource sets occurring within one or more time window(s) indicated by [*higher layer parameter*]. The UE is expected to obtain DL RSCP or DL RSCPD measurement with $N\_{sample}$ = 1 as defined in [11, TS 38.133].**Comment 4: for BW aggregation**The following description is not aligned with the agreement. When positioning SRS collides with other signal which has low priority, the SRS is not dropped. The agreement is for the case when positioning SRS in one CC has lower priority than other signals and dropped.Here is our suggestion:-------------------------------For the linked SRS resource sets for bandwidth aggregation across CCs, if an SRS configured by the higher layer parameter *SRS-PosResource* collides with other signals or channels on a symbol and is the SRS in that symbol is dropped, SRS transmission of the linked SRS resource sets across all CCs is dropped on that symbol**Comment 5: for BW aggregation**As Intel commented, Option 1 in the following agreement needs to be captured in Clause 6.2.1.4.

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| Option 1 in the following agreement needs to be captured in Clause 6.2.1.4. **Agreement**With regard to aperiodic positioning SRS for bandwidth aggregation for UEs in RRC\_CONNECTED state, support both Option 2 and Option1.* Option 2: Support to use a DCI format 0\_3 or 1\_3 for multi-cell PDSCH/PUSCH scheduling to trigger SRS resources for bandwidth aggregation in multiple CCs.
* Option 1: Support a Rel-17 single DCI scheduling positioning SRS resource sets across the linked carriers, as a separate UE capability.
	+ Reuse Rel-17 DCI framework without modification.
	+ If a single DCI indicates transmission of an aperiodic positioning SRS resource set, UE transmits aperiodic positioning SRS resource sets across all linked carriers for bandwidth aggregation.
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**Comment 6: for SL**With regard to the following agreement, the report should be for all already transmitted SL PRS resources. The wording can refer to the description for SRS Tx TEG ID reporting

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| **Agreement(RAN1#114)**For location calculation, the ARP ID of SL PRS transmission can be informed to another UE or LMF by Tx UE informing the association between ARP ID and the already transmitted SL PRS resource(s) as assistance data.38.214 Rel-17 SRS Tx TEG ID: the UE shall report the association information of the already transmitted SRS resources configured by the higher layer parameter *SRS-PosResource* with the UE Tx TEG ID |

Here is our suggestion:-------------------------------The UE may report the association information of the already transmitted SL PRS resources with UE Tx ARP ID as assistance data.**Comment 7: for SL**There is no agreement that DCI format 3\_0 is reused for shared pool. We think it is still FFS whether DCI 3\_0 or DCI 3\_2 should be used. Hence, we suggest put the following sentence in bracket.----------------[In sidelink resource allocation mode 1 for a shared resource pool, the time domain behaviour for sidelink dynamic grants and sidelink configured grants for SL PRS follows the behaviour in clause 8.1.2.1.]**Comment 8: for SL**Both Rx and Tx timestamp may be reported based on the agreement in which Tx timestamp may be optional. ------------------For the SL RSTD, SL Rx-Tx time difference, SL RTOA, SL AoA, SL PRS-RSRP, and SL PRS-RSRPP measurements, the UE may report an associated timestamp via higher layer parameter [*sl-prs-time-stamp*], where the timestamp can be associated with a SL PRS reception time and may optionally further be assoicated with a SL PRS transmission time. The timestamp includes the SFN, slot number, and optionally *nr-PhysCellID*, *nr-ARFCN*, *nr-CellGlobalID*, or the timestamp includes DFN and slot number.  |  |
| Sharp | * **Comment #1, on 8.2.4.1.1:**

On the first bullet for shared RP, we suggest the following editorial changes (there is no need to mention the parameter(s)),

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| - the number of contiguous symbols for SL PRS transmission, ‘M’, shall correspond to one of the SL PRS resources configured in the slot. |

* **Comment #2, on 8.2.4.1.1:**

On the third bullet for shared RP, it is more accurate to use the same wording as the previous (i.e. 2nd) bullet, which makes it clear that PSSCH DMRS is first mapped, and SL PRS should avoid mapping to symbols already used by PSSCH DMRS,

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| - the UE shall not transmit SL PRS in symbols where PSSCH DMRS is transmitted. |

* **Comment #3, on 8.2.4.1.1:**

On shared RP, the RAN1 working assumption also mentions PT-RS, SL CSI-RS, AGC and GAP. It is unclear why these were not captured by the Editor.* **Comment #4, on 8.2.4.1.1:**

On the last bullet for shared RP,

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| - For comb sizes of 1, 2, 4, the UE shall not transmit PSSCH and SL PRS in the same symbol. |

Since the UE shall determine symbols for SL PRS prior to determining symbols for PSSCH, this bullet should actually be moved to 8.1.2.1 (i.e. for determining symbols for PSSCH, symbols for SL PRS shall be excluded; it is NOT feasible to do it the other way around, i.e. “exclude symbols for PSSCH when determining symbols for SL PRS”).(And agree with Intel that there is no need to mention “comb sizes of 1, 2, 4” because those are all the comb sizes supported for a shared RP)* **Comment #5, on 8.2.4.1.1:**

On the second bullet for dedicated RP, same suggestion as in Comment #1.

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| - the number of contiguous symbols and the starting symbol for SL PRS transmission shall correspond to one of the SL PRS resources configured in the slot. |

* **Comment #6, on 8.2.4.1.1:**

On the last two paragraphs, there has not been any RAN1 agreement on the actual DCI format(s) for scheduling SL PRS. At least the sentence ““DCI format 3\_0” is replaced by “DCI format 3\_2”” should be removed, and the two paragraphs should be put around brackets.* **Comment #7, on 8.2.4.2:**

On “SL PRS/PSCCH transmission”, unlike in SL communications where a reported “resource” is really used for both PSSCH and PSCCH transmissions (hence the term “PSSCH/PSCCH” in legacy spec being reasonable), in a dedicated RP, the UE reports a subset of SL PRS resources, each corresponding to a SL PRS transmission (see the definition of a candidate single-slot resource $\_{}$ in the draft CR), so “SL PRS transmission” should instead be used.* **Comment #8, on 8.2.4.X:**

On the first sentence, the following change is proposed (because each SL PRS resource correspond to a SL PRS transmission)

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| The set of slots and SL PRS resources for SL PRS transmissions is determined by the resource used for the PSCCH transmission containing the associated SCI format 1-B |

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| xiaomi | **Comment 1: In all the section 8.**The terminologies for SL PRS resource allocation is “Scheme 1” and “Scheme 2”, which are not “mode 1” and “mode 2” in SL communication, so whether we need to differentiate the terminology for these two cases may need to be clarified.**Comment 2: In section 8.1**The last two bullets of the below working assumption may need to be reflected.

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| Working assumptionThe number of bits in the embedded SCI format field of SCI format 2-D is 2 bits* If the “Embedded SCI format” field is set to 00, the SCI 2-A fields are included with necessary padding
* If the “Embedded SCI format” field is set to 01, the SCI 2-B fields are included
* If the “Embedded SCI format” field is set to 10, “size of SCI 2-B” number of reserved bits are included
* If the “Embedded SCI format” field is set to 11, “size of SCI 2-B” number of reserved bits are included
* Note: the size of SCI format 2-D is the same regardless of the value of the embedded SCI format field
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**Comment 3: In section 8.2.4**“SL PRS frequency domain allocation” is only need for a shared resource pool.

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| - [*SL PRS frequency domain allocation*] indicates the frequency location [and the number of resource blocks for SL PRS transmission in a shared resource pool.] |

**Comment 4, on 8.2.4.1.1:**On the first bullet for shared RP, we agree with Sharp’s view that “in parameter” is confusing and no need to mention the parameter and propose an “at least”. Besides, The description for DMRS symbols should align with the description for PSFCH symbols, and it is better to put them in the same level.

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| For a shared resource pool, the UE transmits the SL PRS in PSSCH symbols according to clause 8.1.2.1, [with the following restrictions:- the number of contiguous symbols for SL PRS transmission, ‘M’, shall correspond to at least one of the SL PRS resources configured in the slot.- the UE shall not transmit SL PRS in symbols where associated PSCCH is transmitted- The UE shall not transmit SL PRS in symbols where PSSCH DMRS is transmitted.- the UE shall not transmit SL PRS in symbols where PSFCH is transmitted.- the UE shall transmit SL PRS only after the last symbol with second stage SCI.- For a given value of ‘M’, SL PRS resource is mapped to the last consecutive ‘M’ SL symbols in the slot that meet the other restrictions- For comb sizes of 1, 2, 4, the UE shall not transmit PSSCH and SL PRS in the same symbol.] |

And also, a brackets should be added for DCI format 3\_2 because RAN1 needs to further decide whether a new DCI format should be introduced or reuse the legacy one.

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| * [“DCI format 3\_0” is replaced by “DCI format 3\_2”.]
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**Comment 5, on 8.2.4.1.2:**

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| For a shared resource pool, the frequency domain resource assignment of a SL PRS resource is the same as PSSCH transmission by the same UE in the same slot. |

**Comment 6, on 8.2.4.2:**We proposal the following modification to make the description clearer:

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| The UE shall perform this procedure according to clause 8.1.4, with the following modifications:* Partial sensing is not applicable in a dedicated SL PRS resource pool;
* A candidate single-slot resource for transmission $R\_{x,y}$ is defined as the SL PRS resource with index $x$ ,which shall belong to the Set of SL-PRS resource ID(s) provided by the higher layer and in slot $t'\_{y}^{SL}$
* “SCI format 1-A” is replaced by “SCI format 1-B”,
* In step 5 TODO
* In condition b of step 6, the RSRP measurement is the PSCCH DMRS-RSRP;
* In condition c of step 6 “determines according to clause 8.1.5 the set of resource blocks and slots” is replaced by “determines according to clause 8.2.4.X the set of slots and SL PRS resources”;
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**Comment 7, on 8.2.4.X:**For clarification, we propose the following modifications:

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| If [*sl-MaxNumPerReserve]* is 2 then the index of the SLPRS resource in the second scheduling SL slot is indicated by the field [Resource ID indication].[ If [*sl-MaxNumPerReserve]* is3 then the index of the SL PRS resource in the second/third scheduling SL slot is indicated by the field [ Resource ID indication].] |

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| LGE | Comment 1:We suggest to remove “in PSSCH symbols” in the following sentence in Section 8.2.4.1.1, because it is contradictory to the other sentence highlighted below.8.2.4.1.1 Resource allocation in time domainFor a shared resource pool, the UE transmits the SL PRS ~~in PSSCH symbols~~ according to clause 8.1.2.1, [with the following restrictions:* For comb sizes of 1, 2, 4, the UE shall not transmit PSSCH and SL PRS in the same symbol.]

Comment 2:We suggest to capture the following agreements.**Agreement**Multiple (M,N) pairs within a slot in a dedicated resource pool is supported only when the different (M, N) pairs are always multiplexed via TDM to different sets of symbols in a slot. Only a single (M,N) value can be mapped within one TDM duration (i.e. one set of symbols).Recommended text is as follows.In a dedicated resource pool, only a single {M, N} value can be mapped within one TDM duration in a slot, where M is the number of SL PRS symbols and N is the comb size. Different {M, N} values across different TDM duration can be mapped.Comment 3:We suggest the following clarification on the current text in Section 8.2.4.1.2, according to the following conclusion.For a dedicated resource pool, the ~~frequency domain resource assignment~~ bandwidth of a SL PRS resource is the same as that of the resource pool.**Conclusion**For a dedicated resource pool, only the case where SL PRS bandwidth is the same as resource pool bandwidth is supported in Rel-18.Comment 4:SL PRS resource can be only a part of a slot. To make the sentence clear in that point, we suggest the following clarification in the current text in Section 8.2.4.2.A candidate single-slot resource for transmission $R\_{x,y}$ is ~~defined as~~ replaced by the SL PRS resource with index $x$ within the Set of SL-PRS resource ID(s) provided by the higher layer and in slot $t'\_{y}^{SL}$ |  |