**3GPP TSG-RAN WG2 Meeting #123bis** **R2-230XXXX**

**Xiamen, China, 9th – 13th Oct, 2023**

**Title: Summary of [Post123][403][POS] Sidelink positioning MAC issues (Huawei)**

**Source: Huawei, HiSilicon**

**Agenda item: 8.2.2**

**Document for: Discussion and Decision**

# Background

The following email discussion has been triggered based on the post meeting discussion for the summary in the sidelink positioning

* [Post123][403][POS] Sidelink positioning MAC issues (Huawei)

 Scope: Further progress the discussion from [AT123][431], prioritising issues related to SL-PRS resource allocation.

 Intended outcome: Report to next meeting

 Deadline: Long

In this email discussion, we intend to visit the issues defined within the scope of the email discussion

## Contacts

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# Discussion

MAC layer performs the SL-SCH data transmission with following procedures, which can be shown as the following figure.



1. **SL-SCH transmission is requested:** With SL grant reception and TX resource selection, UE can obtain the SL grant via network scheduling or the selection from the resource pool provided by the network or pre-configuration.
2. **SL grant is obtained**: For each SL grant associated with a new transmission, the MAC layer selects the destination and LCH based on the LCP and construct the MAC PDU.
3. **Transmission of the SL grant**: the constructed MAC PDU is transmitted in the SL grant.

For the SL PRS transmission, we assume the similar procedure should also be supported, which can be shown as the follow figure.



When the SL PRS transmission is requested, the UE can request the SL grant from gNB or select the TX resources. When the SL grant is indicated or selected, the UE can determine the content transmitted on the SL grant. After the content is determined and the SL grant is coming, the SCI and the associated MAC PDU and/or SL RPS are transmitted on the SL grant.

## 2.1 SL Grant generation for SL PRS transmission

### 2.1.1 SL PRS resource requested in Scheme 1

#### ***Discussion on dynamic grant***

In the TX resource request for the SL-SCH data transmission, SL-BSR MAC CEs are used to indicate the gNB the data buffer status as in the following figure.



The buffer sizes of LCGs are included in decreasing order of the highest priority of the sidelink logical channel having data available for transmission in each of the LCGs irrespective of the value of the Destination Index field. This can help the gNB obtain the buffer sizes of the highest LCG from different destinations as much as possible when the SL-BSR is trucated.

When a SL PRS transmission is triggered, UE can request the transmission resource for the SL PRS in Scheme 1. According to the agreement achieved in RAN2#123, new MAC CE can be sent for SL PRS resource request.

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| When aperiodic/one-shot SL-PRS transmission is triggered for UE configured with Scheme 1 SL-PRS resource allocation, at least for the case when LMF is not involved in giving the grant, design a new MAC CE for the UE to send to the gNB for SL-PRS resource request. |

Furthermore, RAN1 has agreed that the related information sent in the resource allocation request shall be determined by the other working groups.

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| AgreementFrom RAN1 perspective, for scheme 1 SL-PRS resource allocation for a UE requiring to transmit SL-PRS, the serving gNB may receive a request for specific SL PRS resource characteristic(s)/SL-PRS resource configuration(s). * Up to other WGs to decide on the appropriate signaling and details on SL PRS characteristic(s) and/or SL-PRS configuration(s) request
 |

Based on the agreement above, RAN2 needs to discuss the content of the MAC CE in this email discussion. We thus would like to ask the open-ended question below on what are the parameters that companies think are needed in the MAC CE.

***Question1*: What parameters are needed in the MAC CE to request the SL PRS resources?**

|  |  |
| --- | --- |
| Companies  | Comments |
| Ericsson | The MAC CE may contain at least one of the below information* One or multiple indicators indicating that the UE requests SL PRS resources for one or multiple positioning sessions/procedures
	+ Wherein each indicator is associated with a positioning session/procedure
* One or multiple indices of positioning sessions/procedures which need SL PRS resources to be allocated to the UE
* One or multiple time periods which indicate the time periods during which the requested SL PRS resources to be valid for the UE
	+ Wherein each time period is associated with a positioning session/procedure
	+ There may be a common time period which is applicable to all positioning sessions/procedures
 |
| ZTE | At least destination and priority of SL-PRS transmission should be indicated in the UL MAC CE |
| Sharp | At least Destination of the SL PRS transmissions, ID of the UE to assign SL PRS resources to (if not the same as that of the UE sending the request), priority, bandwidth, type of resource pool (i.e. shared or dedicated), number of SL PRS resources, resource reservation interval if applicable, and delay budget. |
|  |  |

On the MAC CE for requesting SL-PRS resource, there are cases that the UE is able or unable to send the MAC CE to the gNB. For cases when the MAC CE cannot be sent i.e., UL-SCH resources cannot accommodate the MAC CE, it needs to be further discussed whether SR needs to be sent to the gNB for UL-SCH request.

***Question2:* Do companies agree that when UL-SCH resource cannot accommodate SL-PRS resource request MAC CE plus its subheader, the UE should send SR to the gNB, either by PUCCH or PRACH?**

|  |  |  |
| --- | --- | --- |
| Companies  | Yes/No | Comments |
| Ericsson | Yes | Same as in the legacy |
| ZTE | Yes | SR and UL MAC CE is always coupled |
| Sharp | Yes |  |

The next issue is the how to cancel the MAC CE when it is triggered. The status of the MAC CE needs to be considered because if the MAC CE is pending while not cancelled, the UE will always try to send the MAC CE for any UL-SCH transmission. While for the SL-PRS resource request MAC CE, we think it can be cancelled as long as it is transmitted in the UL.

***Question3:* Do companies agree that the** **SL-PRS resource request MAC CE can be cancelled when it is transmitted?**

|  |  |  |
| --- | --- | --- |
| Companies  | Yes/No | Comments |
| Ericsson | Yes | Same as in the legacy |
| ZTE | Yes | It is also the normal procedure when UL MAC CE is used. Q3 should be ‘**the SL-PRS resource request MAC CE can be cancelled when it is ~~transmitted~~ triggered**’  |
| Sharp | Yes with comments | We think it could be cancelled just as SL BSR MAC CE. However, to avoid the missing of the SL-PRS resource request MAC CE, a similar retransmission timer just like what we have for SL BSR MAC CE could be helpful. |
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The same question also exists for the cancellation of SR. We think that similar to the cancellation of SL-PRS resource request MAC CE, the SR can be cancelled when the MAC CE is transmitted

***Question4:* Do companies agree that the SR triggered by SL-PRS resource request MAC CE can be cancelled when the MAC CE is transmitted?**

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| --- | --- | --- |
| Companies  | Yes/No | Comments |
| Ericsson | Yes | Same as in the legacy |
| ZTE | Yes |  |
| Sharp | Yes |  |
|  |  |  |

#### ***Configured grant type 2***

In addition to DG, in the previous RAN1 meeting, RAN1 has also agreed that both CG type 1 and type2 can be configured for the resource allocation for SL-PRS. For CG type1, in the last RAN2 meeting, RAN2 has agreed that the CG type 1 configuration can be requested by RRC message. While it remains to be discussed, when the CG type 2 configuration is delivered to the UE, how does the UE request the activation/deactivation of the CG type2 resource when positioning needs to be performed.

***Question5:* Do companies agree that the activation/deactivation of the CG type2 can be requested by the UE sending a MAC CE?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | No | In the legacy, there is no request message for SL UE to the gNB requesting activation or deactivation for either type 1 or type 2. The SL UE can just report *SidelinkUEInformationNR or SL BSR to the gNB. it is up to the gNB determine whether to initiate a dynamic grant or configured grant. SidelinkUEInformationNR provides traffic pattern, QoS profile related information, while the SL BSR gives more dynamic buffer status information and QoS priority.*If it is sufficient to apply the same/simiar logic as in the legacy.No need to introduce a request MAC CE for CG type 2 specifically. UE just provides a RRC message (e.g., *SidelinkUEInformationNR extended to include SL positioning related QoS info) or a SL potioning resource request MAC CE (as covered in Question 1) to the gNB, so that the gNB decide by its implementation whether to assign a dynamic positioning resource, or a configured grant type or configured grant Type 2.* |
| ZTE | No | There is no need to introduce a request message for activation/deactivation for CG type 2. there is no such legacy mechanism either. |
| Sharp | No | The new MAC CE for SL PRS resources request will be enough. Base on the request, gNB could activate the CG type 2. |
|  |  |  |

For configured grant type 2, CG type 2 in the legacy releases are reused as baseline according to the agreement. For configured grant type 2, if the resource in the dedicated resource pool is activated/deactivate by the new DCI 3\_x, similar to legacy releases, a CG confirmation MAC CE needs to be triggered and sent to the gNB by the UE when the UE successfully decodes the DCI. If the resource in the shared resource pool is activated/deactivate by the legacy DCI, also the legacy CG confirmation MAC CE needs to be triggered and sent to the gNB.

***Question6*: Do companies agree that a CG confirmation MAC CE is needed when the DCI for CG type 2 activation/deactivation is successfully received?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | yes | Same as in the legacy |
| ZTE | Yes  | It is a normal design |
| Sharp | Yes | As legacy |
|  |  |  |

While for the activation/deactivation request, if the question above is agreeable, the next question would be what will be the format of the request of activation/deactivation of CG type 2. We would like to ask the similar open question below that what will be the contents of the new MAC CE

***Question7:* What contents are needed in the CG type 2 activation/deactivation request MAC CE?**

|  |  |
| --- | --- |
| Company | Comments |
| Ericsson | We think the request MAC CE is not needed. |
| ZTE | Do not support the request MAC CE of CG type 2 |
| Sharp | As we comments in Q5, the new MAC CE for SL PRS resources request could be considered as an activation request. We don’t see the necessary to design an deactivation request MAC CE. |

For the CG confirmation, current spec has already defined a MAC CE for CG type 2, but only for the legacy SL communications without considering the SL-PRS. The format of the MAC CE is as follows:

|  |
| --- |
| Figure 6.1.3.34-1: Sidelink Configured Grant Confirmation MAC CE |

The legacy spec has specified that there can be in total 8 CG configurations configured for a UE. And the code point within the CG configuration MAC CE corresponds to the index in the CG configuration.

***Question8*: Do companies agree that the legacy Sidelink Configured Grant confirmation MAC CE can be reused for the CG for SL-PRS transmission?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | No | Good to define a separate confirmation MAC CE, since the positioning session/procedure and the legacy SL configured grant configuration index may have overlapping value spaces.for the new MAC CE, it is sufficient to use the same payload as the legacy MAC CE, we only needs to define a separate LCID (E.G., eLCID) |
| ZTE | No for now | RAN1 does not confirm whether there are still 8 CG configs when SL-PRS joins the transmission in Rel-18. So we should wait for RAN1’s conclusion then to discuss whether to reuse the legacy MAC CE |
| Sharp | Yes with comments | If no extension is required, the legacy Sidelink Configured Grant confirmation MAC CE can be reused |

### 2.1.2 SL PRS resource selection in Scheme 2

In legacy resource selection procedure for mode 2, for each sidelink process which is associated with a HARQ buffer, the MAC entity triggers the pool selection procedure (if it is not done) and triggers the TX resource (re-)selection check procedure to make sure whether TX resource selection should be performed. When the TX resource selection is triggered, the parameters are provided to the PHY layer to obtain the candidate TX resource sets and MAC layer select the SL grant from the candidate TX resource.

Similarly, for scheme 2, when the SL PRS transmission is requested, the MAC layer shall first select the transmission pool from configured resource pool(s) and then trigger the TX resource (re-)selection check procedure. Then obtain the SL grant from the TX resource sets.

#### ***Resource pool selection***

During the discussion in R2#122, the following remaining issues have been concluded after the email discussion during the meeting

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| To be postponed to the post meeting email discussionProposal5: RAN2 to further discuss the following on the resource pool selection for SL-PRS transmission in resource allocation Scheme 2: Whether both shared resource pool and dedicated resource pool for SL-PRS can be configured at the same time Whether to leave the RP selection between dedicated and shared RP to the UE’s implementation If not leave it to the UE’s implementation, whether to prioritize the dedicated resource pool when only SL-PRS is pending for transmission |

We first try to discuss on the question on whether shared and dedicated RP can be configured at the same time. From our understanding, the shared RP are the same as the legacy RP in configuration. While dedicated RP can be used for sidelink PRS transmission, data transmission for PC5 signaling, SLPP is still needed that RP with data transmission functionality has to be configured. Thus, we think shared RP and dedicated RP can be configured at the same time and would like to ask the following question.

***Question9:* Do companies agree that dedicated/shared RP can be configured at the same time?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | May be ok | Same as in the legacy  |
| ZTE | Yes | We think UE can always be configured by the gNB with dedicated pool and shared pool simultaneously, and UE can transmit SL-PRS on shared and dedicated RP simultaneously for the same scheme (i.e., scheme 1 or scheme 2) |
| Sharp | Yes, but | We do not share the understanding that “the shared RP are the same as the legacy RP in configuration”.According to the following RAN1 WA, a legacy RP is only a “shared RP” when it comes with SL PRS resource configuration:Working assumptionFor 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.
 |

With respect to the pool selection, the SL PRS can be transmitted in the dedicated resource pool or in the shared resource pool. In the legacy pool selection for sidelink process, if the selection is triggered by discovery message and discovery pool is configured, the discovery pool is selected. This can restrict the UE to transmit discovery message in the discovery pool if configured, and reduce the occupation of the discovery message in the pools for communication. Similar to the dedicated resource pool, only the SL PRS is allowed to transmit, it may better fulfil the service requirements.

As both dedicated resource pool and shared resource pool can be configured for the UE, when the resource selection for SL-PRS is triggered, the UE can select the resource pool as following options.

**Select the dedicated resource pool first if dedicated resource pool is configured**

**Select the resource pool based on pending transmission: if there is SL-SCH data and SL PRS pending, select the shared pool; if only SL PRS is pending, select the dedicated pool.**

**By UE implementation**

**Other (if any, please list)**

Companies are invited to answer the following question

***Question10*: Which option is needed for the resource pool selection when resource selection is triggered for SL-PRS transmission? If there are other options, please list within comments**

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| --- | --- | --- |
| Companies  | Supporting options | Comments |
| Ericsson | Option c is sufficient |  |
| ZTE | Option c | We do not think explicit rules for MAC to choose pool is needed.* If there is SL PRS and SL data, MAC can choose a legacy(Rel-17) pool for SL data, and a dedicate pool for SL-PRS; MAC can also choose a shared pool to transmit both;
* If there is only SL PRS, MAC can choose dedicated pool, MAC can also choose the shared pool because RAN1 has confirmed the feasibility that shared pool can transmit SL-PRS and empty data.

So we see it is totally MAC’s own decision, depending on MAC’s scheduling situation |
| Sharp | a) | We prefer a simple solution i.e. dedicated resource pool is always used if available. |

Another question to ask is the when the resource selection procedure is triggered for SL-SCH data while there is no SL-PRS pending for transmission, which resource pool should be selected. We think that this case corresponds to the legacy scenario for data transmission without SL-PRS transmission. In this case, the dedicated resource pool should not be selected.

***Question11:* Do you agree that when RP is selected for LCH, dedicated pool should not be selected?**

|  |  |  |
| --- | --- | --- |
| Companies  | Yes/No | Comments |
| Ericsson | yes |  |
| ZTE | Yes | If the selection is only for SL data transmission, this statement is ok |
| Sharp | Yes |  |

#### ***TX resource (re-)selection check related issues***

For the TX resource (re-)selection check procedure, the following conditions are used,

|  |
| --- |
| If the TX resource (re-)selection check procedure is triggered on the selected pool of resources for a Sidelink process according to clause 5.22.1.1, the MAC entity shall for the Sidelink process:1> if PSCCH duration(s) and 2nd stage SCI on PSSCH for all transmissions of a MAC PDU of any selected sidelink grant(s) are not in SL DRX Active time as specified in clause 5.28.3 of the destination that has data to be sent; or1> if *SL\_RESOURCE\_RESELECTION\_COUNTER* = 0 and when *SL\_RESOURCE\_RESELECTION\_COUNTER* was equal to 1 the MAC entity randomly selected, with equal probability, a value in the interval [0, 1] which is above the probability configured by RRC in *sl-ProbResourceKeep*; or1> if the pool of resources is configured or reconfigured by RRC; or1> if there is no selected sidelink grant on the selected pool of resources; or1> if neither transmission nor retransmission has been performed by the MAC entity on any resource indicated in the selected sidelink grant during the last second; or1> if *sl-ReselectAfter* is configured and the number of consecutive unused transmission opportunities on resources indicated in the selected sidelink grant, which is incremented by 1 when none of the resources of the selected sidelink grant within a resource reservation interval is used, is equal to *sl-ReselectAfter*; or1> if the selected sidelink grant cannot accommodate a RLC SDU by using the maximum allowed MCS configured by RRC in *sl-MaxMCS-PSSCH* associated with the selected MCS table and the UE selects not to segment the RLC SDU; orNOTE 1: If the selected sidelink grant cannot accommodate the RLC SDU, it is left for UE implementation whether to perform segmentation or sidelink resource reselection.1> if transmission(s) with the selected sidelink grant cannot fulfil the remaining PDB of the data in a logical channel, and the MAC entity selects not to perform transmission(s) corresponding to a single MAC PDU:NOTE 2: If the remaining PDB is not met, it is left for UE implementation whether to perform transmission(s) corresponding to single MAC PDU or sidelink resource reselection.NOTE 3: It is left for UE implementation whether to trigger the TX resource (re-)selection due to the latency requirement of the MAC CE triggered according to clause 5.22.1.7.2> clear the selected sidelink grant associated to the Sidelink process, if available;2> trigger the TX resource (re-)selection. |

When the shared pool is selected which is triggered by a SL PRS transmission request, since SL-SCH and SL-PRS will be transmitted together, all of the legacy conditions for resource selection should be adopted.

***Question12*: Do companies agree that the legacy conditions for resource selection/reselection check can be reused when the shared pool is selected?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Yes |  |
| ZTE | Yes but | Agree with other reselection conditions.For *sl-ReselectAfter,* we think a little enhancement is needed:Each single grant (each transmission opportunity) in a grant for shared pool is used to convey SL-SCH, or SL-SCH and SL-PRS. The SL-PRS can be transmitted in either initial transmission opportunities or re-transmission opportunities of this grant. If the legacy mechanism is still adopted when SL-PRS transmission occurs, UE will be hard to reach the *sl-ReselectAfter* since it is hardly that SL-PRS and SL-data can BOTH be quiet on several consecutive resource reservation intervals. It will be a long time before the UE can switch grant if it finds the grant inappropriate. Since for scheme 2 selected grant, NW does not know exactly the volume of data and SL-PRS transmission request triggering from UE’s own higher layer at real time, gNB may not make such wise decision on choosing the value of *sl-ReselectAfter.*So we suggest that: for shared pool, the number of unused transmission opportunities on resources indicated in the selected sidelink grant is incremented by 1 **when every single grant resource is not used (including initial transmission opportunities on resource and retransmission opportunities on resource).** |
| Sharp | Yes |  |

When dedicated resource pool is selected, the legacy check conditions which is per sidelink process should be evaluated again.

For the dedicated resource pool, we think that at least the following conditions are not needed.

1. if PSCCH duration(s) and 2nd stage SCI on PSSCH for all transmissions of a MAC PDU of any selected sidelink grant(s) are not in SL DRX Active time as specified in clause 5.28.3 of the destination that has data to be sent.
	* Reason: for dedicated resource pool, there is only a single stage SCI and whether DRX is supported for dedicated resource pool needs further discussion
2. if the selected sidelink grant cannot accommodate a RLC SDU by using the maximum allowed MCS configured by RRC in *sl-MaxMCS-PSSCH* associated with the selected MCS table and the UE selects not to segment the RLC SDU
	* Reason: when SL-PRS is transmitted on dedicated resource pool, there is no MCS configured

***Question13:* Do companies agree that the legacy conditions for resource selection/reselection can be the baseline when the dedicated pool is selected? If additional conditions are needed, add them within comments.**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Yes |  |
| ZTE | Yes but | Agree with the old condition.The following new condition should be considered:Currently, the selected grant in dedicated pool is only maintained by the Tx UE for one ‘process’. If there are many SL-PRSs pending for transmission at a time, UE cannot use a parallel process to select grant for SL-PRS transmission in dedicated pool. So UE should reselect the legacy grant to suit the plenty of SL-PRS transmission request (maybe reselect to a grant with smaller periodicity) |
| Sharp | Yes |  |

***Question14:* Do companies agree that the above condition a) and b) are not needed for the resource selection/reselection in the dedicated pool?**

|  |  |  |
| --- | --- | --- |
| Companies  | Supporting options | Comments |
| Ericsson | Tend to agree that the both conditions are for data, not for PRS | But what will be the spec change? In our view, no additional spec change is needed. The UE just trigger resource reselection if any of the conditions is met. The above condition a) and b) will never be met, but no need to be removed from the spec. in this case, the resource reselection trigger conditions (captured as they are in the spec) are applicable to both SL PRS and the legacy SL communication. Unless the RAPP intended to capture the resource reselection trigger conditions separately for SL PRS transmission. |
| ZTE | Yes |  |
| Sharp | Yes |  |

While, another condition in legacy for the resource reselection is the remaining PDB condition as below:

if transmission(s) with the selected sidelink grant cannot fulfil the remaining PDB of the data in a logical channel, and the MAC entity selects not to perform transmission(s) corresponding to a single MAC PDU

While, in the last RAN1 meeting, RAN1 has agreed that there will be a similar concept for SL-PRS, which is called “SL-PRS remaining delay budget”. We think that for resource reselection, this can be similarly applied.

***Question15*: Do companies agree that if the transmission with the selected grant cannot fulfill the remaining SL-PRS delay budget when multiple SL-PRS transmissions are selected?**

|  |  |  |
| --- | --- | --- |
| Companies  | Yes/No | Comments |
| Ericsson | yes |  |
| ZTE | Yes | The wording can be ‘if transmission(s) with the selected sidelink grant cannot fulfil the remaining DB of the SL-PRS transmission, and the MAC entity selects not to perform transmission(s) corresponding to a single SL-PRS transmission’ |
| Sharp | Yes |  |

#### ***TX resource selection parameter related issues***

When the TX resource (re-)selection is triggered, the following parameters are selected for the resource selection including:

1. Resource reservation interval
2. *COUNTER* value
3. Number of HARQ retransmissions
4. frequency resources within the range

If the shared resource pool is triggered, and there is SL-SCH data to transmit, it is reasonable to follow the legacy resource selection procedure and select the legacy parameters.

***Question16*: Do companies agree that the legacy parameters for resource selection/reselection can be reused as baseline when the TX resource (re-)selection is triggered in the shared resource pool?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Yes |  |
| ZTE | Yes |  |
| Sharp | Yes |  |

If the dedicated resource pool is selected, as agreed by RAN1, SL-PRS transmission by periodic reservation is supported for dedicated resource pool. Since there is no SL-SCH data to transmit and no HARQ process in the dedicated resource pool, the HARQ number seems not needed for select the resource. For the legacy COUNTER value which is associated with HARQ process to enable the UE to reselect the resource for the next sensing period when the COUNTER value reduce to 0, similar mechanism can be applied.

Then, the following parameters are supported when the TX resource (re-)selection is triggered in the dedicated resource pool:

1. resource reservation interval, when the transmission of multiple SL-PRS is triggered
2. *COUNTER* value, when the transmission of multiple SL-PRS is triggered
3. other parameters (if any, please add)

***Question17*: Which parameters are needed when the TX resource (re-)selection is triggered in the dedicated resource pool?**

|  |  |  |
| --- | --- | --- |
| Companies  | Supporting options | Comments |
| Ericsson | a and b |  |
| ZTE | A,b,c | The number of SL-PRS re-transmissions should also be selected by the Tx UE.SL-PRS does not need to provide ACK/NACK feedback, but non-periodic resource reservation is also supported by RAN1. The non-periodic reserved resource should be interpreted as ‘re-transmission’, maybe with the different resource, but with the same SL-PRS transmission characteristics (priority, session, DB, etc.). |
| Sharp | a), b) |  |

#### ***Priority for SL transmission with both data and SL-PRS***

In the last RAN1 meeting, the following has been agreed and a LS R1-2308559, has been sent to RAN2 on the SL-PRS priority

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| As part of Rel-18 WI on Expanded and Improved NR Positioning, related to SL positioning, RAN1 discussed priority handling at the physical layer for SL PRS and/or PSSCH in a slot of a dedicated or a shared resource pool and made the following agreement.

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| --- |
| Agreement* For a slot, a single priority value is provided by higher layers to the physical layer and is used at least to determine the PSSCH and/or SL-PRS transmission power via the value of $P\_{MAX,CBR}$.
	+ For dedicated resource pool, this corresponds to the priority level of SL PRS.
	+ Send an LS to RAN2 requesting them to take the above into consideration when defining priority levels for SL PRS and PSSCH that are multiplexed in the same slot of a shared resource pool.
 |

RAN1 also made the following conclusion related to priority and congestion control, and RAN1 expects the same handling of priorities for shared resource pool as the above agreement.

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| **Conclusion**For Scheme 2 SL-PRS resource allocation, with regards to the congestion control for a shared RP, CBR and CR mechanisms from Rel.16 NR SL are reused.* Add this agreement in the LS related to the priority handling
 |

Actions**To RAN WG2** **ACTION:** RAN1 respectfully asks RAN WG2 to take the above agreement and conclusion into account when defining priority levels for SL PRS and PSSCH that are multiplexed in the same slot of a shared resource pool. |

Hence, RAN2 needs to discuss how to determine the priority used by L1 and sent in SCI that MAC delivers to PHY. For dedicated resource pool, it has been quite clear that the L1 priority is the priority of SL-PRS; while for shared resource pool, it is possible that (a) both data from SL-SCH and SL-PRS are transmitted (b) only SL-PRS is transmitted (c) only data from SL-SCH is transmitted.

***Question18:* Do companies agree that when both SL-SCH data are transmitted and SL-PRS are transmitted on shared resource pool, the priority that MAC indicates to PHY is the higher priority of the two?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Yes |  |
| ZTE | Yes |  |
| Sharp | Yes |  |

Currently, the selection of the following parameters are related to the priority

* Number of HARQ retransmissions
* Amount of frequency resources
* MCS selection

One issue is when only SL-PRS is transmitted on shared resource pool, how to determine the priority of the data (including only the MAC subheader) that is not associated with any logical channel. As can be seen above, on shared resource pool, the priority of data is needed for the selection of HARQ retransmissions, amount of frequency resources and MCS selection. The question is how to determine the priority when there is only SL-PRS transmitted on shared resource pool.

***Question19:* Do companies agree that the priority of the data should follow the priority of PRS when there is only SL-PRS pending for transmission on shared resource pool?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Yes | But Isn’t so that in this case, the UE shall attempt to use dedicated resource pool? |
| ZTE | No | There is no need to introduce priority associated with empty data. For the selection of HARQ retransmissions, amount of frequency resources and MCS selection, if there is no data pending to transmit, MAC can take the SL-PRS priority to determine these parameters within the range of SL-PRS dedicated Tx parameters configured by RRC (i.e., can introduce a new RRC IE dedicated for SL-PRS Tx parameters, similar like SL-PSSCH-TxConfigList). |
| Sharp | Yes |  |

## 2.2 Resource allocation for the SL Grant on different resource pools

In the SL resource allocation for the SL-SCH data transmission, for each upcoming SL grant, the MAC entity should:

1. Select a destination and logical channels
2. Allocate the SL resource

According to the rules of using the SL grant, the data with higher priority is transmitted first, which follows the priority adopted as follows.

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| --- |
| Logical channels shall be prioritised in accordance with the following order (highest priority listed first):- data from SCCH;- Sidelink CSI Reporting MAC CE;- Sidelink Inter-UE Coordination Request MAC CE and Sidelink Inter-UE Coordination Information MAC CE;- Sidelink DRX Command MAC CE;- data from any STCH. |

### 2.2.1 SL Grant in dedicated resource pool

When UE obtains a grant in the dedicated resource pool, it may have multiple SL PRS transmission pending which are sent to different destinations. Similar to the SL-SCH data transmission, the transmission of the SL PRS is to support a kind of service. It is reasonable that if the SL grant can fulfil multiple transmission request of the pending SL PRS transmissions, the SL PRS which has higher priority should be transmitted first, with the agreed 8 priority levels for SL-PRS. Therefore, one option is to select the destination that has the highest priority of the SL PRS for the SL grant in dedicated resource pool.

***Question20*: Do companies agree that for a SL grant in dedicated resource pool, MAC layer selects the destination that has the highest priority of the SL PRS for transmission?**

|  |  |  |
| --- | --- | --- |
| Companies  | Yes/No | Comments |
| Ericsson | Yes |  |
| ZTE | Yes but | Agree with the highest-SL-PRS-priority mechanism for dedicated pool. For the description, we think that for dedicated pool, UE should select the destination that has the highest priority of the SL PRS for transmission **per PSCCH duration on this grant**, not per grant |
| Sharp | Yes |  |

### 2.2.2 SL Grant in shared resource pool

#### ***Destination selection***

When the UE is obtained a grant in the shared resource pool, it may have multiple SL PRS transmission pending and multiple SL-SCH transmission pending which are sent to different destinations.

For the pending SL-SCH data, it may contain the following:

1. **LCH data from the SCCH**, i.e., higher layer signaling (PC5-S message/PC5-RRC message/Sidelink discovery message)
2. **MAC CE**, i.e., MAC layer signaling (Sidelink CSI Reporting MAC CE/ Sidelink Inter-UE Coordination Request MAC CE and Sidelink Inter-UE Coordination Information MAC CE/Sidelink DRX Command MAC CE)
3. **LCH data from STCH**, i.e., traffic data.

For the pending SL PRS transmission, it belongs to a service provided by the upper layer, and it is more like the transmission of the STCH data. Also,PHY layers cannot identify the urgency level of the transmission data or SL PRS. Therefore, if the SL grant in the shared resource pool can fulfil multiple transmission request, MAC layers can determine whether the pending SL PRS is transmitted in the SL grant and which pending SL PRS is transmitted.

Considering the STCH data and the SL PRS are both information transmitted to support the higher layer service, and it is also agreed the SL PRS has 8 priority levels which is same as the LCH, the reasonable handling of selecting the destination of the SL Grant in the shared resource pool is based on the comparison of the pending data and pending SL PRSes.

***Question21*: Do companies agree that for a SL Grant in shared resource pool, MAC layer selects the destination with the highest priority of the SL PRS, LCH data, MAC CE?**

|  |  |  |
| --- | --- | --- |
| Companies  | Yes/No | Comments |
| Ericsson | Yes |  |
| ZTE | No | SL-Data’s 8 configured priority level is only applied to LCH data from STCH, which refers to SL-SCH LCID 4-19:

|  |
| --- |
| TS38.321:Logical channels shall be prioritised in accordance with the following order (highest priority listed first):- data from SCCH;- Sidelink CSI Reporting MAC CE;- Sidelink Inter-UE Coordination Request MAC CE and Sidelink Inter-UE Coordination Information MAC CE;- Sidelink DRX Command MAC CE;- data from any STCH. |

So we think SL-PRS’s 8 priority level should **only be compared with LCH data from STCH**, not MAC CE and LCH data from the SCCH |
| Sharp | Yes |  |

#### ***Multiplexing issues after destination is selected***

If the destination has the SL PRS pending, the multiplexing and assembly to construct MAC PDU associated with the SL grant between the SL PRS and the LCH data and/or MAC CE(s) should be considered.

There are following options for multiplexing and assembly,

1. SL PRS is always transmitted when there is pending SL PRS under the selected destination.
2. SL PRS is only transmitted when SL PRS is the highest priority under the selected destination.
3. SL PRS is only transmitted when the SL-SCH data with higher priority than the SL PRS is already allocated in the MAC PDU.
4. Other (if there is options not listed, please fill here)

***Question22*: Which option is supported when the destination of the shared resource pool is already selected when there are both SL-PRS and data pending for transmission?**

|  |  |  |
| --- | --- | --- |
| Companies  | Yes/No | Comments |
| Ericsson |  | Question seems unclear. I guess, SL PRS transmission is just a L1 RS transmission, which doesn’t rely on/need a MAC PDU to be built, right?But for other SL PRS signaling transmission, I think they will be associated with SL LCHs as in the legacy, then UE just follows the legacy LCP procedure. No additional spec change is needed either. |
| ZTE | B with comments | The question is unclear. How can UE determine the selected destination when both SL-PRS and SL-data pending to transmit? Does the question assume the selected destination is based on the pending data with the highest priority, like legacy LCP procedure? Then what if SL-PRS has higher priority than the pending data? This should be the first question to discuss.(b) seems most reasonable here.However the issue is, for (b), a UE may have several POS sessions and there may be many SL-PRS with all kinds of priority pending to transmit. **If UE always transmit SL PRS with the highest priority, then UE will never have a chance to transmit lower priority SL-PRS (but this lower priority also associates with a session and has QoS and DB). Then the session may fail frequently.** To ensure the low priority data still has a chance to transmit, legacy data transmission has a mechanism to control each logical channel’s data flow. Here we suppose the SL-PRS transmission should also address the issue. |
| Sharp | c) |  |

Since based on the RAN1#114 working assumption, the symbol number occupied by the SL PRS will affect the calculation of the TBS.

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| --- |
| Working assumptionIn the shared resource pool, if SL PRS is multiplexed in slot, for the determination of a transmission of a TB, the UE shall determine the number of REs (NRE) within the slot as $$N\_{RE}^{'}=N\_{sc}^{RB}\left(N\_{symb}^{sh}-N\_{symb}^{PSFCH}-N\_{symb}^{SL-PRS}\right)-N\_{oh}^{PRB}-N\_{RE}^{DMRS}$$where $N\_{symb}^{SL-PRS} $represents the number of OFDM symbols used for SL PRS in the slot. |

Therefore, after the MAC layer determine whether a SL PRS is transmitted in the SL grant, the PHY layer can determine the TBS.

Then it is reasonable, for a SL grant which PHY layer provides the TBS considering the SL PRS occupation, the MAC layer can allocate SL-SCH based on legacy LCP rules to construct MAC PDU associated with the SL grant.

***Question23*: Do companies agree that if a SL PRS is transmitted in the SL grant in the shared pool, legacy LCP rules can be performed to construct MAC PDU associated with the SL grant after TBS with the consideration of SL PRS is provided?**

|  |  |  |
| --- | --- | --- |
| Companies  | Yes/No | Comments |
| Ericsson | Yes |  |
| ZTE | Yes but | We agree with the understanding, but currently there is no specified procedure in both RAN1 and MAC specification that PHY tells TBS to the MAC (to let MAC generate the MAC PDU). So we see no spec impact of this ‘reuse’ at least in RAN2 specification |
| Sharp | Yes |  |

#### ***MAC PDU generation issues***

In the previous running CR, the following has been captured as FFS for shared resource pool:

Editor's NOTE: Whether SL-SCH is transmitted when no data in logical channel is trasnmitted along with SL-PRS transmission and whether HARQ operations are needed for this case.

While, during the previous RAN1 meeting, the fields for SCI have been agreed for SL-PRS on shared resource pool. So, there is HARQ process even for the case when there is no data from SL-SCH: within the embedded SCI format 2-A and 2-B, there are HARQ process ID included.

|  |
| --- |
| AgreementIn a shared resource pool, with regards to the fields in SCI format 2-D, include the following fields: * SL PRS resource information indication of the current slot – ceiling(log2(#SL-PRS resources (pre-)configured in the resource pool) bits)
* SL PRS request – 0 or 1 bit
* Embedded SCI format – [X] bit(s)
	+ If the “Embedded SCI format” field is set to [0], the SCI 2-A fields are included with necessary padding
	+ If the “Embedded SCI format” field is set to [1], the SCI 2-B fields are included
 |

For shared resource pool, SL-PRS needs to be transmitted together with a SL MAC PDU subheader carrying a source/destination ID. The following conditions have been specified for the MAC PDU generation

|  |
| --- |
| The MAC entity shall not generate a MAC PDU for the HARQ entity if the following conditions are satisfied:- there is no Sidelink CSI Reporting MAC CE generated for this PSSCH transmission as specified in clause 5.22.1.7; and- there is no Sidelink DRX Command MAC CE generated for this PSSCH transmission as specified in clause 5.22.1.8; and- there is no Sidelink Inter-UE Coordination Request MAC CE generated for this PSSCH transmission as specified in clause 5.22.1.9; and- there is no Sidelink Inter-UE Coordination Information MAC CE generated for this PSSCH transmission as specified in clause 5.22.1.10; and- the MAC PDU includes zero MAC SDUs. |

Based on the current specified conditions, the MAC entity will not generate MAC PDU if the MAC PDU includes zero MAC SDUs and zero MAC CEs. While, for the transmission of SL-PRS without SL-SCH data, since there is no MAC SDUs, according to the current spec, MAC PDU will not be generated and cannot transmit the MAC subheader, which contains the source and destination layer-2 ID. To support the case that the SL-PRS transmitted without data in the SL grant in the shared resource pool, the constraint on the MAC PDU construction needs to be broken, e.g., the MAC PDU is not allowed to be constructed when there is no MAC SDUs , no MAC CEs and no SL-PRS.

***Question24*: Do companies agree that if the selected destination only has pending SL PRS, the MAC entity should generate MAC PDU containing only padding MAC subPDU for the transmission along with SL-PRS?**

|  |  |  |
| --- | --- | --- |
| Companies  | Yes/No | Comments |
| Ericsson |  | “For shared resource pool, SL-PRS needs to be transmitted together with a SL MAC PDU subheader carrying a source/destination ID. The following conditions have been specified for the MAC PDU generation”Uncertain for this statement, is it already agreed in RAN1 or RAN2? If the answer is yes, then agree with the RAPP’s suggestion that, the existing rules needs to be updated. |
| ZTE | Yes |  |
| Sharp | Yes |  |

## 2.3 DRX

In R17, DRX was introduced for sidelink communication with the intention of power saving, also supported under all the cast modes. Similarly, power consumption is a very important evaluation metric for the SL positioning. UE is benefit if we have the DRX to save the power.

For the SL-PRS transmitted via the shared resource pool, since the DRX has been supported for the legacy NR sidelink transmission, it is reasonable that it should be supported for shared resource pool for SL-PRS transmission. There also does not seem to be spec change required for supporting this.

While for SL-PRS transmitted via the dedicated resource pool, it has been agreed that there will not be PSSCH and PSFCH along with the SL-PRS transmission on the dedicated resource pool. Consider the timer operation for DRX associated HARQ procedure, it is better to disable the DRX when the dedicated pool is configured for the UE. Therefore, we propose the following

***Question25*: Do companies think that DRX and dedicated resource pool for PRS transmission should not be configured together?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Not sure | At least timer on-duration, inactivity timer don’t rely on HARQ process |
| ZTE | Yes |  |
| Sharp | No | They could work separately. |

## 2.4 Collision handling

The SL-PRS may be transmitted in both the dedicated resource pool and the shared resource pool. For both shared and dedicated resource pool, it can be seen above that they both have L1 priority, that even for shared RP, one L1 priority is aggregated from PRS priority and data priority. We think that the Collison handling can be based on the L1 priority between Uu and SL as in legacy.

***Question26*: Do companies support collision handling between SL/UU for SL-PRS based on the L1 priority?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Yes |  |
| ZTE | Yes |  |
| Sharp | Yes |  |

Then, another question is how to handling the collision when it happens between Uu and PC5. We also think that the legacy mechanism can be reused for the collision between PUCCH/PUSCH and SL-PRS/PSSCH/PSCCH.

***Question27:* Do companies agree that SL-PRS is prioritized over PUSCH/PUCCH when**

* **The value of the priority of PUSCH/PUCCH is higher than a threshold, as in legacy**
* **The value of the priority of SL-PRS is lower than a threshold**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Yes |  |
| ZTE | Yes |  |
| Sharp | Yes |  |

# 3 Summary

TBD