**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

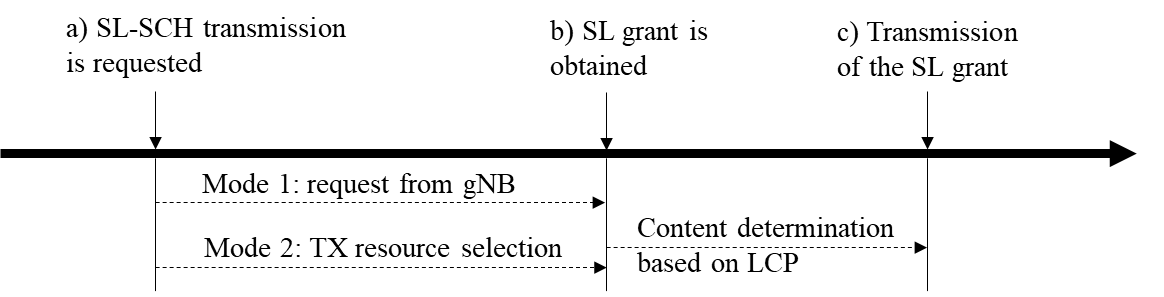
In this email discussion, we intend to visit the issues defined within the scope of the email discussion

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|  |  |  |
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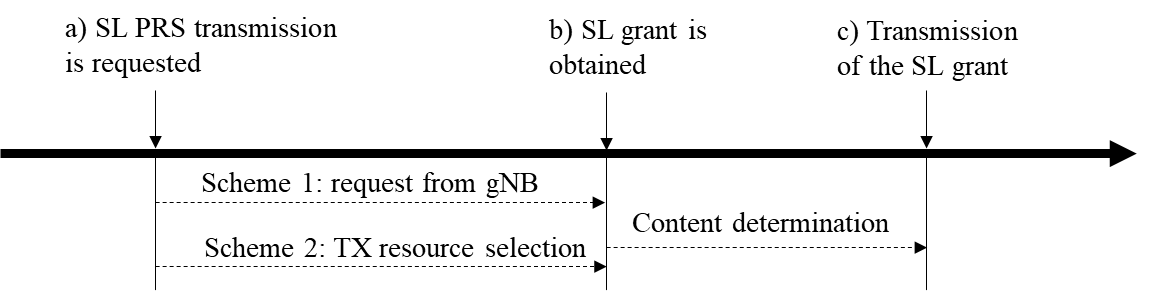
# Discussion

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.

|  |
| --- |
| 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.

|  |
| --- |
| Agreement  From 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. |
| OPPO | SL-PRS priority to be determined by the higher layer |
| CATT | Destination ID(s) and priorities of SL-PRS transmission from the Tx UE side at least. |
| vivo | Inspired by BSR MAC CE, there should primarily be the destination for the SL-PRS reception. Moreover, from the perspective of a certain UE, if there is multiple triggering of SL-PRS for different destinations, the SL-PRS request MAC CE can be arranged as a decreasing order of SL-PRS priority (i.e. the value is from small to large). Priority is also used when gNB to schedule SL grant for different SL transmission types, i.e. when SL data and SL-PRS are both request for scheduled SL grant.  Apart from that, the gNB needs to know about each required SL-PRS bandwidth, periodicity in case of the periodic SL positioning session, in order to allocate the appropriate SL grant for SL PRS transmission.  Besides, there can be multiple SL-PRS instances of the mentioned information.  To sum up, SL-PRS request MAC CE should include multiple sets of fields indicating:   1. Destination 2. Bandwidth 3. Periodicity 4. Priority |
| Xiaomi | At least the following:   1. Bandwidth 2. Priority   Others FFS |
| InterDigital | We consider that at least these parameters are needed.   * Layer-2 ID * Priority value of SLPP/LCS QoS. * The total number of resources for SL-PRS (re-)transmission. * Required bandwidth for SL-PRS.   From our view, required bandwidth is needed. It is related to the SL positioning method and SL positioning performance (e.g., accuracy) |
| Intel | Given that the request for SL-PRS is quite different from SL-SCH data transmission, more information may be needed. For instance:   * The specific SL-PRS resources, e.g. slot and SL-PRS resource ID * TX UE L2 ID (UE which performs SL-PRS transmission), since the requesting UE may be different than the anchor UE * SL-PRS priority information * SL-PRS transmission related parameters (which may require input from RAN1)   In general, we think that whatever RAN2 decides, it would be good to confirm with RAN1 |
| Huawei | We think the following parameters can be carried on the MAC CE.   1. Destination index: to indicate the destination that has SL PRS transmission is triggered 2. Priority: to help gNB identify the priority of the pending SL PRS 3. Requested bandwidth: determined by the higher layer service request. 4. Requested time duration in one slot: determined by the higher layer service request.   At least a) and b) are needed. Other can be optional carried. |
| Lenovo | MAC CE may consist of the required assistance information in order for the gNB to appropriately allocate SL-PRS resources for aperiodic/one shot transmissions. These may include the following:   1. Required SL Pos. QoS including absolute/relative/ranging for distance/ranging for direction accuracy, positioning latency, etc. 2. Recommended SL-PRS parameters including at least SL.PRS resource ID, which relate to the comb offsets, comb size (N), starting, symbols, starting symbols, SL PRS transmission bandwidth. 3. SL-PRS Priority Information 4. Destination L2-ID list |
| Samsung | Before considering the specific parameter in the MAC CE, we need to discuss what information the UE can provide for the gNB to help SL-PRS resource allocation in general. And this issue is also related to the way of resource scheduling in the shared/dedicated RP.  In the shared RP, the resource allocation will be given with the bulk of contiguous SL radio resource with the granularity (Time: slot, Frequency: sub-channel) even for SL-PRS as in the legacy. Considering this aspect, we think the following information can be provided for the gNB for SL-PRS resource scheduling in the shared RP case. **\* Destination of the requested SL-PRS  \* SL-PRS Bandwidth**  Meanwhile, in the dedicated RP, the resource allocation can be made with the pattern of non-contiguous SL radio resource with higher granularity (Time: symbol, Frequency: RE) compared to the legacy resource scheduling in the shared RP. Thus, for the dedicated RP case, the UE can provide the additional assistance information for the gNB in addition to the aforementioned information for the shared RP case. **\* SL-PRS pattern information (e.g., Comb size N, Symbol length M)**  In addition, if any requirement on SL-PRS QoS (e.g., priority, scheduling delay …) is given by upper layers (e.g., SLPP), the requirement can be also provided by the UE for the gNB in both cases. **\* SL-PRS delay requirement \* SL-PRS priority**  All the aforementioned information for SL-PRS scheduling can be delivered from the UE to the gNB via either RRC signalling (e.g., SUI) or MAC signalling (e.g., MAC CE). Thus, we can further discuss which signalling method will be used for the delivery of each information. For that, we assume that the new MAC CE for SL-PRS resource scheduling request can be commonly used for both the shared RP and the dedicated RP. Also, we can also consider the size of each information and the timing at which the information is needed at the gNB side to determine the signalling method. Considering all these aspect, we summarize our view as below.  **In SidelinkUEInformationNR,** \* List of L2 DST ID for SL-PRS \* Requested SL-PRS Bandwidth, Symbol length(M), Comb size(N) \* SL-PRS delay requirement (e.g., SL-PRS delay budget) \* SL-PRS priority  **In the new MAC CE for SL-PRS,** \* Destination index (it corresponds to the order of the reported L2 DST IDs in SUI message) |

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 |  |
| OPPO | Yes |  |
| CATT | Yes |  |
| vivo | Yes |  |
| Xiaomi | Yes |  |
| InterDigital | Yes | We agree to send SR based on the legacy procedure (e.g., not accommodate the MAC CE). Even the UL-SCH resource can accommodate SL-PRS request MAC CE, we can consider the SR transmission via PUCCH is also allowed to request the SL-PRS as a separate solution. For example, one or more PUCCH can be configured to SL-PRS request. |
| Intel | Yes | SL PRS resource request is essential enough that SR should be supported |
| Huawei | Yes | Agree to trigger SR. But the legacy SR is bonded with LCH config, which means that legacy SR is used for UE to request UL resource for an LCH, and there is no LCH for SL-PRS, so the SR triggered by this SL-PRS resource request MAC CE should be specific for SL-PRS resource request MAC CE, similar as the SR triggered by Sidelink CSI Reporting MAC CE. |
| Lenovo | Yes | This follows the legacy procedure of triggering an SR transmission to the gNB. |
| Samsung | Yes | If the UE does not have UL-SCH resource enough for the SL-PRS resource request MAC CE, it should send SR to the gNB to get the UL grant needed for sending the MAC CE. We also think that some dedicated SR resource (e.g., sl-PRS-SchedulingRequestId) can be introduced for the SL-PRS resource request MAC CE. |

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. |
| OPPO | Yes |  |
| CATT | Yes |  |
| vivo | Yes with comments | The existing BSR can be cancelled when  - the SL grant(s) can accommodate all pending data available for transmission; or  - a MAC PDU is transmitted and this PDU includes an SL-BSR MAC CE which contains buffer status up to (and including) the last event that triggered an SL-BSR prior to the MAC PDU assembly.  Similar conditions to cancel the SL-PRS resource request MAC CE should be introduced. |
| Xiaomi | Yes |  |
| InterDigital | Yes |  |
| Intel | See comment | From “SL-PRS resource request MAC CE” can be cancelled”, we assume this refers to the cancellation of the SL-PRS resource request procedure when the UE successfully transmits the MAC CE in the UL (the latter should of course be supported)  It would be good to get more clarity on the question whether it is to cancel the allocated SL grant or cancel the transmission of the MAC CE itself as it is not clear from the question |
| Huawei | Yes | In our understanding, legacy BSR cancellation condition can be used as proposed by vivo. |
| Lenovo | Yes | Seems reasonable that the SL-PRS Resource Request MAC CE may be cancelled. |
| Samsung | Yes |  |

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?**

|  |  |  |
| --- | --- | --- |
| Companies | Yes/No | Comments |
| Ericsson | Yes | Same as in the legacy |
| ZTE | Yes |  |
| Sharp | Yes |  |
| OPPO | Yes | If the demand of the transmission resource is satisfied, then it is natural to cancel the MAC CE asking for the transmission resource. |
| CATT | Yes |  |
| vivo | Yes with comment | Additional conditions should be introduced e.g., pending SR shall be cancelled when the SL grant(s) can accommodate all pending data available for transmission in sidelink. |
| Xiaomi | Yes |  |
| InterDigital | Yes |  |
| Intel | Yes |  |
| Huawei | Yes |  |
| Lenovo | Yes |  |
| Samsung | 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?**

|  |  |  |
| --- | --- | --- |
| 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. |
| OPPO | No | Follow the legacy |
| CATT | No | Agree with other companies, there is a legacy mechanism. And there is no need a request because gNB may activate it by itself. |
| vivo | No | According to the current specification, the activation/ deactivation of CG type2 is decided by NW, where UE could only request SL grant via buffer status report procedure, but it cannot request a specific type of SL grant.  As for SL-PRS, there should be no more additional enhancement in the configured grant arrangement. |
| Xiaomi | No |  |
| Intel | No | In our understanding, there is no explicit request for SL CG type 2 via MAC CE. Then, we are not sure why we need to define one for SL-PRS |
| Huawei |  | We think the information for the CG resource activation and deactivation can benefit the UE and provide more information to the gNB for easy realization. This enhancement can be also done in the SL CG type 2 resources. |
| Lenovo | No | No need to introduce such a procedure. This deviates from the legacy mechanism, where activation/deactivation of CG Type 2 is performed by the NW using DCI signalling. |
| Samsung | See our comment. | The UE can report some assistance information for CG configuration to the gNB via UAI message. The following information can be included in UAI message for that. **\* L2 DST ID for SL-PRS \* SL-PRS periodicity, # of periodic SL-PRS Tx, SL-PRS Tx timingOffset \* SL-PRS bandwidth, Symbol length(M), Comb size(N)**  Based on the information above (e.g., SL-PRS Tx timingOffset), the gNB can determine which type of CG to use and when it activates/deactivates SL-PRS Tx in case of CG type 2. Thus, the CG type2 activation/deactivation request via MAC CE doesn’t seem essential to us.  However, if there is the case the UE can’t know when the SL-PRS Tx should be (de)activated at the timing of sending the UAI message, we are open to discuss the CG type 2 activation/deactivation request via MAC CE. |

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 |
| OPPO | Yes |  |
| CATT | Yes |  |
| vivo | Yes |  |
| Xiaomi | Yes |  |
| InterDigital | Yes |  |
| Intel | Yes | Follow legacy behavior |
| Huawei | Yes | Same as in legacy. |
| Lenovo | Yes | Ok to follow legacy confirmation |
| Samsung | Yes | At least for the dedicated resource pool case, a new CG confirmation MAC CE for SL-PRS needs to be introduced. |

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. |
| OPPO | is not needed |
| CATT | No need and please refer to the comments of Q5. |
| vivo | Not needed |
| Intel | Not needed |
| Huawei | If it is existed. Indicate the preferred CG status |
| Lenovo | Not required |

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?**

|  |  |  |
| --- | --- | --- |
| 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 |
| OPPO | No for now | 8 entries may not be sufficient to accommodate the CG indices for both the SL-PRS and data. |
| CATT | No for now | Agree with ZTE. |
| vivo | See comments | Depends on whether there will be separate CG for SL-PRS transmission in addition to the existing 8 CG. |
| Xiaomi | No | Agree with ZTE |
| Intel | Yes with comment | No need to define new MAC CE for SL-PRS only and we can reuse the SL CG confirmation MAC CE. We are also fine to confirm with RAN1 if majority companies prefer to. |
| Huawei | Yes with comments. | Considering that the CG may be the SL grant in the shared pool and the SL PRS can be transmitted via the CG in the shared pool. It may be not appropriate to introduce a new CG separate for the SL PRS transmission. Therefore, the CG in the dedicated resource pool can be also configured as one of the 8 CGs.  Whether the number of CGs needs to be extended due to the introduce of the CGs using dedicated pool, we think it can be discussed later and at least the number of 8 should be supported. |
| Lenovo | See comments | Good to check with RAN1 if there is a need to design a new MAC CE, specifically for SL-PRS. |
| Samsung | No | We understand that the parameters in CG SL-PRS configuration can be different from the parameters in the legacy CG at least for the dedicated pool. Thus, the CG for SL-PRS can be configured separately from the legacy CG using a separate CG list. Considering this aspect, we see the need of introducing a new MAC CE to confirm the type 2 CG for SL-PRS. Fine to check with RAN1. |

### 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

|  |
| --- |
| To be postponed to the post meeting email discussion  Proposal5: 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?**

|  |  |  |
| --- | --- | --- |
| 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 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. |
| OPPO | Yes |  |
| CATT | Yes | Dedicated/shared RP can be configured at the same time, but only TDM multiplexing can be (pre-)configured. |
| vivo | Yes | Up to gNB implementation. |
| Xiaomi | Yes |  |
| InterDigital | Yes | The MAC (e.g., SL MAC) entity expects that at least one dedicates resource pool (and at least one shared resource pool) is always configured at the same time.  Also, we can consider same configuration can be applied to exceptional SL resource pools for OoC case. |
| Intel | Yes | Since shared pool may anyway be configured regardless of need for SL-PRS transmission, we think it is logical that dedicated and shared pools can be configured at the same time |
| Huawei | Yes | Shared RP is used for not only SL-PRS transmission but also SL communication, so UE can be configured with shared RP all the time. Considering NW can also configure dedicated RP for UE, so the shared RP and dedicated RP can be configured together. |
| Lenovo | Yes | One key reason is that the UE should be able transmit/receive SL-PRS (using SL-PRS dedicated resource pool) and at the same time receive SL-PRS and transmit SLPP messages, e.g., measurement report using the shared resource pool.  This is also aligned with the following RAN1 agreement:  RAN1#112bis-e Agreement  For SL-PRS transmission, either dedicated resource pool(s) or shared resource pool(s) or both can be (pre-)configured in the only SL BWP of a carrier.   * A UE can be (pre-)configured with one or more dedicated SL resource pools.   A UE can be (pre-)configured with one or more shared SL resource pools. |
| Sony | Yes |  |
| Samsung | Yes |  |

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**

|  |  |  |
| --- | --- | --- |
| 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. |
| OPPO | Option c | Which resource pool to be used also depend on the positioning QoS requirement. For example, if the response time requirement is stringent, and the shared resource pool is closer to the current time, then the shared resource pool should be chosen. It could be left to UE implementation. |
| CATT | a) and See the comments | We can discuss the situation at first. Precondition: there is SL data within shared resource pool and there is a dedicate pool for SL-PRS. When SL-PRS is transmitting with the SL data, can the dedicated pool be used for SL-PRS at first?  From CATT’s view, we prefer to select dedicated pool for SL-PRS at first for the above situation because of positioning accuracy and reduction of the complexity of positioning procedure. If the dedicated pool is not enough for SL-PRS, then SL-PRS may use the shared resource pool which is a rare case. |
| vivo | b) with comments | If only SL-PRS is pending, UE should select the dedicated RP to avoid collision with SL communication. If no dedicated RP can accommodate the SL-PRS, UE may select the shared RP.  If both SL-PRS and SL-SCH data are pending, the shared RP can be selected. |
| Xiaomi | Option a or option c | Either works. |
| InterDigital | Option a) | We prefer to select dedicated resource SL pool first because the dedicated SL resource pool may be configured enough BW to transmit SL-PRS for SL positioning. For example, a dedicated SL resource pool can be configured with 20MHz (e.g., wider) and shared SL resource pool can be configured with 5MHz.  When an SL data and SL-PRS are triggered, the UE can select the dedicates SL resource pool firstly considering SL-PRS performance and then select shared SL resource pool for the SL data transmission.  Regarding the option c) RAN2 should not be left UE implementation. For example, when an SL pool selection is triggered by an SL data, the dedicated pool can be selected based on UE implementation. There is an issue because dedicates SL resource pool does not comprise PSSCH. Moreover, if an SL data from a LCH which SL HARQ feedback is enabled for the LCH, the SL resource pool should not be selected since the dedicated SL resource pool does not comprise PSFCH.  In RAN2 perspective, a rule for SL resource pool selection is needed. When an SL data is triggered, the UE should not select the dedicated SL resource pool, instead selecting the SL resource pool among the shared SL resource pools.  Also, if we select yes in Q11 (Do you agree that when RP is selected for LCH, dedicated pool should not be selected), then SL resource pool selection seems not UE implementation. |
| Intel | C | We think that rather than having to specify the conditions for when the shared vs dedicated pool is selected (e.g. depending on whether UE has SL-SCH data, availability of resources in shared pool, QoS requirement for positioning, CBR thresholds for each pool, etc.), relying on UE implementation is preferrable. |
| Huawei | A or b | We are ok for all the options. |
| Lenovo | b) | Option b) seems to be a reasonable method for resource pool selection based on triggering of a SL-PRS transmission. |
| Sony | A or C | Tend to think a is most natural, but agree to OPPOs comment that based on OoS, there may be situation when selecting shared RP is more beneficial. |
| Samsung | C | We prefer to leave it to UE implementation. The UE can determine which resource pool to use for SL PRS Tx considering the pending SL-SCH data and/or the pending SL PRS. No need to specify the detailed UE operation for the resource pool selection. |

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 |  |
| OPPO | Yes | In this case dedicated resource pool should not be selected. |
| CATT | Yes |  |
| vivo | Yes |  |
| Xiaomi | Yes |  |
| InterDigital | Yes | Check the comments in Q10. |
| Intle | Yes | It should be clear since dedicated pools are specifically designed for SL-PRS transmission only |
| Huawei | Yes | Dedicated pool cannot transmit LCH data, then it should not be selected when the resource selection is triggered by LCH data. |
| Lenovo | Yes | Agree that a normal SL communication resource pool should be selected if there is no pending SL-PRS transmission. |
| Sony | Yes |  |
| Samsung | Yes | The dedicated pool is only for SL-PRS Tx and should not be used for SL-SCH data Tx. |

#### ***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; or  1> 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*; or  1> if the pool of resources is configured or reconfigured by RRC; or  1> if there is no selected sidelink grant on the selected pool of resources; or  1> 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; or  1> 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*; or  1> 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; or  NOTE 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?**

|  |  |  |
| --- | --- | --- |
| 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 |  |
| OPPO | Yes |  |
| CATT | See comments | For the DRX part, whether conditions for resource selection/reselection of the PSSCH carrying SL-PRS should adopt the DRX rules need FFS. |
| vivo | See comments | Agree that the legacy conditions for resource selection/reselection check can be reused when the shared pool is selected for both SL-PRS and SL-SCH. But if the shared RP is selected for SL-PRS only, the conditions for resource selection/reselection check is similar with dedicated RP in Q13. |
| Xiaomi | Yes | Can be used as baseline. FFS on whether additional changes are needed. |
| InterDigital | Yes |  |
| Intel | Yes |  |
| Huawei | Yes |  |
| Lenovo | Yes |  |
| Sony | Yes |  |
| Samsung | 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.**

|  |  |  |
| --- | --- | --- |
| 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 |  |
| OPPO | Yes |  |
| CAT | Yes |  |
| vivo | Yes |  |
| Xiaomi | Yes |  |
| InterDigital | Yes |  |
| Intel | Yes |  |
| Huawei | Yes |  |
| Lenovo | Yes | Legacy conditions can be starting point for the dedicated resource pool. |
| Sony | Yes |  |
| Samsung | 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 |  |
| OPPO | Yes |  |
| CATT | Yes |  |
| vivo | Yes |  |
| Xiaomi | Yes | Whether DRX is applied for dedicated resource pool needs further discussion. |
| InterDigital | Yes |  |
| Intel | Yes |  |
| Huawei | Yes |  |
| Lenovo | Yes | Agree that a) and b) are not needed. Furthermore SL DRX handling considering SL-PRS is not within the scope of Rel-18. |
| Sony | Yes |  |
| Samsung | 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 |  |
| OPPO |  | It is Ok from technical perspective, but RAN2 didn’t discuss how to derive the SL-PRS remaining delay budget. |
| CATT | Yes |  |
| vivo | Yes with comments | The condition is decoupled with multiple transmissions. If so, suggest refine as:  if the transmission with the selected grant cannot fulfill the remaining SL-PRS delay budget and the MAC entity selects to not to perform the SL-PRS transmission. |
| Xiaomi | Yes |  |
| InterDigital | Yes |  |
| Intel | See comment | We agree with the principle, but as commented above, the remaining SL-PRS delay budget needs to be defined. It is worth noting that in MAC spec, the following note is captured in section 5.22.1.1:  NOTE 3C: How the MAC entity determines the remaining PDB of SL data is left to UE implementation.  Therefore, we need to discuss if the same principle is applied to the SL-PRS delay budget as well. Another option is to link this delay budget to the SL-PRS priority as defined in the last RAN2 meeting.  Also, note that the question seems incomplete because of the wording… |
| Huawei | Yes |  |
| Lenovo | Yes | Agreeable with the concept in principle. Further discussion is required on how the SL-PRS delay budget is provided since it is different from the legacy packet delay budget. |
| Samsung | Yes | The SL-PRS delay budget can be provided by the upper layer (e.g., LPP or SLPP). |

#### ***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?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Yes |  |
| ZTE | Yes |  |
| Sharp | Yes |  |
| OPPO | Yes |  |
| CATT | Yes |  |
| vivo | Yes with comments | If shared RP is selected for SL-PRS transmission only, the essential parameters are the same with Q17. |
| Xiaomi | Yes as baseline |  |
| InterDigital | Yes |  |
| Intel | Yes |  |
| Huawei | Yes |  |
| Lenovo | Yes | Legacy parameters can be a starting point. |
| Sony | Yes |  |
| Samsung | Yes | The SL-PRS delay budget can be provided by the upper layer (e.g., LPP or SLPP). |

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) |  |
| OPPO | A and b |  |
| CATT | a, b and c | The number of SL-PRS re-transmissions should also be selected by the Tx UE. RAN1 has agreed that supporting the retransmission of SL-PRS in dedicated resource pool |
| vivo | a and b |  |
| Xiaomi | a,b |  |
| InterDigital | All |  |
| Intel | A, b | At least A and B are needed |
| Huawei | A ,b | At least A and B are needed |
| Lenovo | a), b) | a) and b) are reasonable parameters for the dedicated resource pool |
| Samsung | a, b | In general, SL-PRS could be transmitted consecutively several times rather than one-shot. Considering the multiple SL-PRS Tx, both parameter a) and b) seem needed. |

#### ***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

|  |  |  |
| --- | --- | --- |
| 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.   |  | | --- | | 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 .   + 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.   |  | | --- | | **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?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Yes |  |
| ZTE | Yes |  |
| Sharp | Yes |  |
| OPPO | Yes |  |
| CATT | Yes |  |
| vivo | Yes |  |
| Xiaomi | Yes |  |
| InterDigital | Yes | Agree, but having a concern to clarify this.  For example, #1 (SL data with priority 8, SL-PRS with priority 2) -> defining priority level as “2” in the slot, #2 (SL data with priority 4, SL-PRS with priority 8) -> defining priority level as “4” in the slot.  Based on direct comparison, SL data #2 has higher priority than #1, but defining priority level is determined lower priority than #1 (e.g., 4). Moreover, resource type of SL-data and SL-PRS would be different. PQI for SL data may have different resource type with PDB (e.g., GBR/non-GBR/Delay critical GBR) and SL-PRS may not have different resource type. |
| Intel | Yes | We are fine to support the indication of the higher priority when considering both SL data and SL-PRS for the shared pool. |
| Huawei | Yes | The priority in the SCI depends on the highest priority of the SL data and SL PRS in the associated SL grant. |
| Lenovo | Yes with Comments | Agree but share InterDigital’s concern that the SL-PRS priority for data and SL-PRS are based on different mappings, i.e. SL-PRS priority is based on SL Pos. QoS while SL data priority is based on PQI (U-plane Transport QoS). Further discussion is required on whether this is a one-to-one mapping and can be fairly compared. |
| Samsung | Yes | When both SL-SCH data and SL-PRS are transmitted together, it seems reasonable to use the higher priority of the two. |

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 |  |
| OPPO | Yes | If dedicated resource pool is not configured, the UE has to use the shared resource pool |
| CATT | Yes |  |
| vivo | Yes |  |
| Xiaomi | Yes |  |
| InterDigital | Yes |  |
| Intel | Yes | As defined in the last meeting, the SL-PRS priority has 8 levels for use in MAC LCP procedures, so it can be directly used (similar to LCH priority) |
| Huawei | Yes | If the shared pool is selected for the SL PRS resource selection, we can use the 8-level priority for the SL PRS transmission. |
| Lenovo | Yes | The SL-PRS priority may be followed for data. |
| Samsung | 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.

|  |
| --- |
| 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 |  |
| OPPO | Yes | Details could be further discussed |
| CATT | Yes |  |
| vivo | Yes | If a SL grant is obtained in a dedicated RP, there can be only one SL-PRS transmission associated with such SL grant. If there is more than one SL-PRS being triggered, SL grant should firstly satisfy SL-PRS transmission with the highest-priority, and then determine the destination accordingly. |
| Xiaomi | Yes |  |
| InterDigital | Yes |  |
| Intel | Yes | We assume this was the intention for defining 8 levels of priority for SL PRS |
| Huawei | Yes |  |
| Lenovo | Yes | Highest priority destination may be initially selected. |
| Sony | Yes |  |
| Samsung | 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 |  |
| OPPO | Yes | Still the highest priority of the SL PRS, LCH data, MAC CE could be decided, if the SL-PRS priority level is equivalent to the priority of LCH data from STCH |
| CATT | Yes | With the priorities. |
| vivo | Yes | No matter the SL grant is scheduled by NW via DCI/RRC, or triggered via SCI or SLPP and selected by itself, the MAC entity should treat each type of SL transmission with transmitting opportunity through the decreasing order of priority.  To select the destination, the highest priority of SL transmission is employed to decide the peer UE and further to filtrate possible pending transmissions under the same destination. |
| Xiaomi | Yes |  |
| InterDigital | Yes, but | We do not think the determination to select destination for SL-PRS should be based on priority only. The MAC needs to consider other parameter, such as an SL grant in a shared SL resource pool (e.g., sufficient bandwidth, number of (re-)transmission) to satisfy the QoS requirement for SL positioning service.Based on the condition of the SL grant, the MAC can determine whether to transmit SL-PRS with the SL grant or not. |
| Intel | Yes | Same comment as above, i.e. we can directly compare the priorities for determining the destination in the shared pool |
| Huawei | Yes | Agree with ZTE. We believe the SL PRS is a part of a service which should not be prioritized over signalling message even when the priority value is equal to 1, i.e., SCCH data and MAC CE have higher priority and transmit first comparing with the SL PRS. |
| Lenovo | Yes, but | Share Intedigital’s view |
| Samsung | 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) |  |
| OPPO | c | In our understanding, the question assumes that the destination is already selected based on the mechanism discussed in the Question 21. Then, it is natural to accommodate the SL-SCH and MAC CE with higher priority than the SL-PRS and towards the target destination to be accommodate in the shared resource firstly. |
| CATT |  | When the destination is selected, data and signal will be sent following the priorities of them. |
| vivo | c |  |
| Xiaomi | c |  |
| InterDigital | d) | Even when the destination having SL-PRS pending is selected, the UE may determine whether to transmit SL-PRS in the grant based on whether the grant satisfy the required property of SL-PRS (e.g., bandwidth, number of (re-)transmissions). If the grant satisfies the requirement of SL positioning, then we prefer option a). |
| Intel | C | If we consider both SL-PRS and SL LCH data as just serving different services, then we think a fair comparison should be done between the two, i.e. option c. |
| Huawei | c | Agreed with OPPO. We believe the SL PRS is a part of a service which should not be prioritized over signalling message, i.e., SCCH data and MAC CE. The principle of the transmission should be that the high priority information should be transmitted first. |
| Lenovo | Option a) | Whenever there is pending SL-PRS it should be transmitted to selected destination with or without data. |
| Samsung |  | We have the similar view with OPPO, CATT, and Intel.  The MAC layer can select which data/SL-PRS to be accommodated in the transmission block to the selected destination by comparing the priority level between SL-PRS, LCH data and MAC CE. |

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

|  |
| --- |
| Working assumption  In 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  where 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 |  |
| OPPO | Yes |  |
| CATT | Yes |  |
| vivo | Yes |  |
| Xiaomi | Yes |  |
| InterDigital | Yes |  |
| Intel | Yes |  |
| Huawei | Yes |  |
| Lenovo | Yes |  |
| Samsung | 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.

|  |
| --- |
| Agreement  In 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 |  |
| OPPO | Yes | It is necessary to solve the problem how to transmit the SL-PRS without real data in the shared resource pool |
| CATT |  | It depends on whether the SL-PRS can be sent in shared resource pool when there is only SL-PRS to transmit. |
| vivo | Yes |  |
| Xiaomi | Yes |  |
| InterDigital | Yes |  |
| Intel | Yes with comment | If we follow the current LCP design, the MAC PDU generated for SL-PRS may only contain padding.  Also, we are not sure of the relevance of HARQ process ID within the SCI to this question… |
| Huawei | Yes | Agree with OPPO. |
| Lenovo | Yes | The source and destination layer-2 ID need be carried in the subheader of the MAC PDU. |
| Samsung | Yes | The proposed correction seems essential to allow the timely SL-PRS transmission in the shared pool. |

## 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. |
| OPPO | Not sure | If dedicated resource pool and the shared resource pool is configured towards the UE simultaneously, whether or not the DRX should be configured with the UE? |
| CATT | Yes | To reduce the complexity of development. |
| vivo | Yes |  |
| Xiaomi | See comment | It is ok to configure them together, and simply not restrict SL-PRS transmission has to be inside DRX active time, if we don’t want to support this in this release. |
| InterDigital | Not sure | The SL-DRX is configured per pair of source L2 ID and DST L2 ID (e.g., unicast). The TX UE can disable the SL-DRX per pair of source L2 ID and DST L2 ID as below:  In mode 1 resource allocation scheme: The network may not configure the SL-DRX config to the TX UE, if the dedicated SL resource pool is configured (e.g., SL config dedicated NR)  In mode 2 resource allocation scheme: The TX UE (e.g., idle) may not configure the SL-DRX config to the RX UE, if the dedicated SL resource pool is configured (e.g., SIB message).  If SL-DRX operation is not configured/allowed in the dedicated SL resource pool, and SL-DRX operation is configured/allowed in the shared SL resource pool, this is a new UE behaviour. RAN2 needs to discuss regarding this. |
| Intel | See comment | We would like to clarify if this means no DRX is applied for the dedicated pool only or even for the shared pools when dedicated pool is configured.  We assume DRX can be configured for the shared pools but not for the dedicated pool |
| Huawei | Yes | DRX is configured per destination pair instead of per resource pool. This means if the two UEs are configured with DRX operation, when the extension of the on-durations triggered by HARQ related timers, they can align each other by timer status. For the dedicated resource pool, it is agreed that there is no HARQ procedure in the dedicated resource pool, it is not possible to keep HARQ related timers. To handle the case when there is dedicated pool configured, restricting the configuration is easier, i.e., not configure DRX and dedicated resource pool together. |
| Lenovo | Yes | Agree and furthermore SL Positioning power saving features are out of scope of Rel-18 at least for dedicated SL-PRS resource pool. |
| Sony | See comment | Don’t think we should exclude DRX for the dedicated RP options, since DRX can be configured for SL-SCH data which may be configured in parallel with SL-PRS |
| Samsung | Yes |  |

## 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 |  |
| OPPO |  | It should be decided by RAN1. No RAN2 impact is foreseen |
| CATT | Yes | Following the legacy. |
| vivo | Yes |  |
| Xiaomi | Yes |  |
| InterDigital | Yes |  |
| Intel | Yes | Follow legacy behavior |
| Huawei | Yes |  |
| Lenovo | Yes | Ok to follow legacy mechanism |
| Samsung | 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 |  |
| OPPO |  | It should be decided by RAN1. No RAN2 impact is foreseen |
| CATT | Yes |  |
| vivo | Yes |  |
| Xiaomi | Yes |  |
| InterDigital | Yes |  |
| Intel | Yes |  |
| Huawei | Yes |  |
| Lenovo | Yes | Ok to follow legacy mechanism |
| Samsung | Yes | One minor correction on the first bullet sentence as per the expression in the current MAC spec.  The value of the priority of PUSCH/PUCCH is not lower than a threshold, as in legacy |

# 3 Summary

TBD