# **[100b-e-NR-5G\_V2X\_NRSL-SL\_PHY\_Procedure-02] SL/UL prioritization and UL/SL power sharing**

[100b-e-NR-5G\_V2X\_NRSL-PHY-Procedure-02] Email discussion/approval regarding SL/UL prioritization and UL/SL power sharing

* Prioritization in the cases mentioned in RAN2 LS ([R1-2000161](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2000161.zip)), i.e., “how to handle all other physical channels in UL/SL prioritization”
* Prioritization between UL TX and SL TX in case of simultaneous TXs of UL and SL across difference carriers

till 4/23, with potential TPs by 4/28 (Hanbyul, LGE)

**1. SL/UL prioritization for dropping**

Q1 (PSFCH): When PSFCH TX overlaps with UL TX, what is the prioritization rule for dropping?

- Option 1: Use the prioritization rule for UL SCH and SL SCH collision (i.e., the SL transmission is prioritized if the highest priority value of UL LCH(s) with available data is larger than the UL priority threshold and the highest priority value of SL LCH(s) with available data is lower than the SL priority threshold. Otherwise the UL transmission is prioritized.)

- Option 2: Use the LTE rule (i.e., UL TX is down-prioritized if SL-TX is higher than SL-threshold, otherwise prioritized)

- Option 3: Others (please specify it)

Q1-1: Which option do you prefer when PSFCH TX overlaps with UL TX assigned with UL SCH priority by the RAN2 agreements in R1-2000161? Feature lead understands that UL TX in this case includes UL data and UL-triggered SR.

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| Company | Preferred option | Comments |
| NTT DOCOMO | Option 1 | Following collision handling for SL data seems to be reasonable. NR-Uu supports URLLC data. In some cases, UL TX should be prioritized even when SL TX is higher than SL-threshold. |
| Apple | URLLC uplink transmission is prioritized;  Otherwise, Option 2 | If uplink data is URLLC transmission, which is indicated by high “priority field” in DCI, then uplink transmission is prioritized.  Otherwise, LTE rule is applied, where the priority of PSFCH is the same as the corresponding PSSCH data. |
| ZTE, Sanechips | Option 3 | The “i.e. part” of Option 1 says “the SL transmission is prioritized if the highest *priority value of UL LCH(s)* with available data is …”, however, physical layer, which is responsible for dropping of PSFCH-UL overlapping, does not know the priority value of UL LCH. So we prefer to a modified option 1 (we call it option 3) as following:  *The SL transmission is prioritized if the priority index of UL TX is 0 and the highest priority value of SL Tx is lower than the SL priority threshold. Otherwise the UL transmission is prioritized.* |
| Huawei, HiSicon | Option 3 | In NR Uu, the PHY of the UE cannot realize the priority of UL-SCH, because it is a logical channel priority held in MAC. However, non-fallback DCI formats in Rel-16 have a priority indicator for a PUSCH or a PUCCH in dynamic grants, and a similar field is provided in configured grants. This priority indicator indicates whether the priority of the PUCCH/PUSCH is high (e.g., URLLC) or low (e.g. eMBB) in PHY prioritization/multiplexing handling procedure.  We think that any UL TX indicated as “high priority” should be prioritized over SL TX. Otherwise, LTE solution can be reused.  **The proposed scheme for option 3:** UL TX is prioritized if the value of priority index of the PUCCH or PUSCH as indicated by the “Priority indicator” field in the associated DCI or provided by the associated configured grant is 1 (if provided); Otherwise, LTE rule is used.  The same rules of prioritization are also applied to collision between UL Tx and SL Tx including PSSCH or PSSCH + PSFCH. |
| Intel | Option 1 | The RAN2 option based on two thresholds seems most flexible and covers URLLC data cases. PSFCH related thresholds may need to be separately configured, if the priority is not directly comparable to logical channel priorities. |
| OPPO | Option 1 | The priority of PSFCH can be equal as the associated PSSCH. |
| vivo | Option 1 | Maximumly reuse the same framework for all cases |
| CATT | Option 1 | Reuse the same design principle in RNA2. |
| LG | Option 1 | Since the logical channel priority of UL-SCH is available in this case, it would be desirable to consider it for the prioritization between UL and SL.  Currently, gNB could not know the priority of SL at least for Mode 2, so it is not desirable to always prioritize URLLC UL especially when the requirement of SL TX is comparable with that of URLLC UL. Depending on the priority provided by the logical channel priority of URLLC UL-SCH and SL-SCH, the UE can decide whether URLLC UL is prioritized or SL TX with tight requirement is prioritized.  Furthermore, considering that the priority of PSFCH is given by the logical channel priority of the associated SL-SCH, it would be consistent behavior with RAN2 decision. To be specific, according to RAN2 decision, the prioritization between UL-SCH and SL-SCH does not consider “Priority index” in DCI. Instead, the logical channel priority of UL-SCH and SL-SCH are used for the prioritization rule. |

Q1-2: Which option do you prefer when PSFCH TX overlaps with UL TX NOT assigned with UL SCH priority by the RAN2 agreements in R1-2000161? Feature lead understands that UL TX in this case includes PUCCH with HARQ feedback for DL, CSI, LRR, PUSCH without UL-SCH, and SRS. Note that PUCCH carrying SL HARQ reporting will be discussed in a separate question Q3.

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| Company | Preferred option | Comments |
| NTT DOCOMO | Option 3 | Option 2 is applied for CSI report, LRR, PUSCH without UL-SCH, SRS.  For PUCCH with HARQ feedback for DL, the highest priority value of DL LCH(s) corresponding to the HARQ-ACK bits should be used as option 1. Otherwise, HARQ-ACK for URLLC DL data would be dropped. It is undesirable. |
| Apple | URLLC uplink transmission is prioritized;  Otherwise, Option 2 | If PUCCH is associated with URLLC transmissions (e.g., DL HARQ feedback), which is indicated by high “priority field” in DCI, then uplink transmission is prioritized.  Otherwise, LTE rule is applied.  Here, we assume PUSCH also does NOT carry SL HARQ reporting. |
| ZTE, Sanechips | Option 3 | Same as in Q1-1 |
| Huawei, HiSilicon | Option 3 | As in Q1-1, we think that any UL TX associated with the “high priority” indication in DCI or CG should be prioritized over SL TX. These include HARQ feedback for DL, CSI, and LRR. Otherwise, LTE solution can be reused. |
| Intel | Extended Option 2 | Configure two SL priority thresholds: one for regular UL TX priority, the other is for “high” UL TX priority (introduced in eURLLC) |
| OPPO | Option 2 | If UE cannot decode PDSCH correctly (NACK), it cannot determine the priority or service type based on DCI only, and accordingly it cannot determine the priority of the corresponding PUCCH. A unified principle/rule should be applied here no matter UE can or cannot decode PDSCH. In that case, we think option 2 is reasonable. |
| vivo | Option 1 | As commented at Q1-1, we prefer to reuse the same framework as defined by RAN2 for all cases, i.e., separated thresholds for UL and SL transmission. However, the priority of above-mentioned PHY control signaling may be not available, we think it can simply set the priority of UCI, CSI… higher/lower than the UL threshold.  Moreover, In the question, FL mentioned ‘PUCCH with HARQ feedback for DL, CSI, …’, then how about ‘PUSCH with HARQ feedback for DL, CSI, …’ |
| CATT | Reuse option 1 as much as possible | The priority level of these UL Tx can be (pre-)configured. |
| LG | Modified Option 2 | Since the priority of UCI is not defined, for simplicity, it can be considered to reuse the LTE rule.  Meanwhile, SL threshold can be separately (pre)configured for eMBB UL and URLLC UL to handle those cases differently. Since error and latency requirements for NR sidelink could be comparable or more tightened compared to URLLC UL depending on the service type, it is not preferable to always prioritize URLLC UL over NR sidelink. |

Q1-3: At least Option 1 and Option 2 require a priority of PSFCH TX. Do you agree that the priority of PSFCH TX is the highest priority of the associated PSCCH/PSSCH?

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| Company | Answer |
| NTT DOCOMO | OK |
| Apple | Agree |
| ZTE, Sanechips | Agree. |
| Huawei, HiSilicon | Yes |
| Intel | Agree |
| OPPO | Agree |
| vivo | Agree |
| CATT | Agree |
| LG | Yes, we think that the priority of PSFCH TX is the same as the priority of the associated PSCCH/PSSCH. For more than one PSFCH TXs, the highest priority of PSFCH TXs will be used for UL/SL prioritization. |

Q2 (S-SSB): When S-SSB TX overlaps with UL TX, what is the prioritization rule for dropping?

- Option 1: Use the prioritization rule for UL SCH and SL SCH collision (i.e., the SL transmission is prioritized if the highest priority value of UL LCH(s) with available data is larger than the UL priority threshold and the highest priority value of SL LCH(s) with available data is lower than the SL priority threshold. Otherwise the UL transmission is prioritized.)

- Option 2: Use the LTE rule (i.e., UL TX is down-prioritized if SL-TX is higher than SL-threshold, otherwise prioritized)

- Option 3: Others (please specify it)

Q2-1: Which option do you prefer when S-SSB TX overlaps with UL TX assigned with UL SCH priority by the RAN2 agreements in R1-2000161? Feature lead understands that UL TX in this case includes UL data and UL-triggered SR.

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| Company | Preferred option | Comments |
| NTT DOCOMO | Option 1 | Reason is the same as that for above. URLLC UL data should be prioritized. |
| Apple | URLLC uplink transmission is prioritized;  Otherwise, Option 2 | If UL is associated with URLLC transmissions (e.g., URLLC uplink data), which is indicated by high “priority field” in DCI, then UL is prioritized.  Otherwise, LTE rule is applied. |
| ZTE, Sanechips | Option 3 | Same concern as in Q1-1: PHY layer does not know the priority of UL LCH. Our preferred Option 3 is described as following:  *The SL transmission is prioritized if the priority index of UL TX is 0 and the highest priority value of SL Tx is lower than the SL priority threshold. Otherwise the UL transmission is prioritized. The SL priority in case of S-SSB transmission is configured by higher layer.* |
| Huawei, HiSilicon | Option 3 | Since S-SSB TX is not an emergency, UL TX should be always prioritized over S-SSB TX.  This is also equivalent to taking option 2, and defining that S-SSB priority is always higher than SL-threshold. |
| Intel | Same as PSFCH TX | Same handling as PSFCH, but with S-SSB priority derived differently |
| OPPO | Option 2 | While the priority of S-SSB can be set to the largest value, i.e., priority of S-SSB is 7, corresponding to lowest priority.  S-SSB is transmitted in SFN mode. If the UE does not transmit S-SSB because of collision, there is possible other UEs do transmit S-SSB. |
| vivo | Option 1 | As commented for Q1-1 |
| CATT | Option 1 | Same as for Q1-1 |
| LG | Option 1 | Considering output of in-device coexistence, the priority of S-SSB is (pre)configured for prioritization between LTE SL and NR SL. This priority could be reused for applying SL/UL prioritization.  As mentioned in Q1-1, it would be beneficial to consider both the priority of UL TX and the priority of SL TX for the prioritization between UL and SL. |

Q2-2: Which option do you prefer when S-SSB TX overlaps with UL TX NOT assigned with UL SCH priority by the RAN2 agreements in R1-2000161? Feature lead understands that UL TX in this case includes PUCCH with HARQ feedback for DL, CSI, LRR, PUSCH without UL-SCH, and SRS. Note that PUCCH carrying SL HARQ reporting will be discussed in a separate question Q3.

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| Company | Preferred option | Comments |
| NTT DOCOMO | Option 3 | Similarly to Q1-2, Option 2 is applied for CSI report, LRR, PUSCH without UL-SCH, SRS.  For PUCCH with HARQ feedback for DL, the highest priority value of DL LCH(s) corresponding to the HARQ-ACK bits should be used as option 1. Otherwise, HARQ-ACK for URLLC DL data would be dropped. It is undesirable. |
| Apple | URLLC uplink transmission is prioritized;  Otherwise, Option 2 | If UL is associated with URLLC transmissions (e.g., URLLC DL HARQ), which is indicated by high “priority field” in DCI, then UL is prioritized.  Otherwise, LTE rule is applied.  In this case, we assume PUSCH also does NOT carry SL HARQ reporting. |
| ZTE, Sanechips | Option 3 | Same as for Q2-1. |
| Huawei, HiSilicon | Option 3 | See comments in Q2-1. |
| Intel | Extended Option 2 | Configure two SL priority thresholds: one for regular UL TX priority, the other is for “high” UL TX priority (introduced in eURLLC) |
| OPPO | Option 2 | Same as for Q2-1. |
| vivo | Option 1 | As commented in Q1-2 |
| CATT | Reuse option 1 as much as possible | Same as for Q1-2 |
| LG | Modified Option 2 | In a similar manner of the answer in Q1-2, we are supportive of reusing the LTE rule with separately (pre)configured SL threshold for eMBB UL and URLLC UL. |

Q2-3: At least Option 1 and Option 2 require a priority of S-SSB TX. How is the priority of S-SSB determined?

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| Company | Answer |
| NTT DOCOMO | (Pre-)configured.  Flexibility to set priority for S-SSB is preferred since priority of SL operation and that of UL operation are up to scenarios/services/etc. |
| Apple | By (pre)configuration |
| ZTE, Sanechips | (pre-)configured. |
| Huawei, HiSilicon | UL TX is always prioritized over S-SSB TX i.e. the priority value of S-SS/PSBCH block or LTE SLSS/PSBCH should be always larger than the SL priority threshold. |
| Intel | Same pre-configuration mechanism as for in-device co-existence |
| OPPO | (pre-)configured to largest value, i.e., priority of S-SSB is 7, corresponding to lowest priority. |
| vivo | (pre-)configured, reuse what we have specified in co-existence AI |
| CATT | (Pre-)configured |
| LG | As in in-device coexistence, the priority of S-SSB could be (pre)configured. |

Q3 (PUCCH carrying SL HARQ reporting): Do you agree that the priority of PUCCH carrying SL HARQ reporting is the highest priority of the associated PSFCH?

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| Company | Answer |
| NTT DOCOMO | Not support for collision with UL.  OK for collision with SL.  The priority should be known to gNB. Otherwise, gNB needs blind decoding for many UL channels since the PUCCH may be dropped or UL channel other than the PUCCH may be dropped. In addition, UL TX for URLLC-type could be dropped due to the PUCCH for SL HARQ report. The collision is unpredictable at gNB and unavoidable. |
| Apple | Agree |
| ZTE, Sanechips | Ok, but only for collision with SL. |
| Huawei, HiSilicon | Yes. |
| Intel | Prefer not to assign specific priority value associated with PSSCH/PSCCH to PUCCH carrying SL HARQ report. Similar to NTT DOCOMO, our preference is to avoid PUCCH dropping decisions at a UE which can be unknown to gNB, since in general the SL priority operated by a UE may be uncertain to gNB, unless heavily restricted by gNB. |
| OPPO | Agree |
| CATT | Agree |
| LG | Yes, when multiple HARQ-ACK feedbacks are multiplex in a PUCCH, the highest priority of the associated PSFCH can be used for the priority of the PUCCH. |

Q3-1: If answer to Q3 is yes, when PUCCH carrying SL HARQ reporting overlaps with SL TX, do you agree that the one with a higher priority is transmitted?

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| Company | Answer |
| NTT DOCOMO | OK. |
| Apple | Agree. For PUCCH carrying SL HARQ reporting, direct priority comparison between SL HARQ reporting (equal to priority of the associated PSSCH data) and SL TX is applied. The one with a high priority is prioritized.  We think we should also consider the case where PUSCH carrying SL HARQ reporting. This case is a little bit different since PUSCH also contains uplink data, together with SL HARQ reporting. Our proposal is  1. If URLLC uplink data is transmitted, then uplink transmission is prioritized.  2. Otherwise, direct priority comparison between SL HARQ reporting and SL TX:  If SL HARQ reporting has a higher priority than SL TX, then PUSCH is prioritized over SL TX.  If SL HARQ reporting has a lower priority than SL TX, then LTE rule is applied (since we also have uplink data). In other words, if SL TX priority above a threshold, then SL TX is prioritized. Otherwise, uplink transmission is prioritized. |
| ZTE, Sanechips | Agree. |
| Huawei, HiSilicon | Yes. It shall be based on direct comparison. |
| OPPO | Agree |
| CATT | Agree |
| LG | Yes. Since this UL transmission has the priority of SL, it needs to directly compare with the priority of SL transmission. According to SL/UL prioritization made in RAN2, for the case of a PUCCH carrying SR for SL, the UE directly compares the priority of SL SR with the priority of other SL transmission. |
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Q3-2: If answer to Q3 is yes, when PUCCH carrying SL HARQ reporting overlaps with UL TX, do you agree that the rule of UL/SL prioritization applies by treating PUCCH carrying SL HARQ reporting as SL TX?

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| Company | Answer |
| Apple | If UL TX is URLLC UCI, then URLLC UCI is prioritized.  Otherwise, LTE rule is used. In other words, if the SL HARQ reporting has priority higher than a threshold, then SL HARQ reporting is prioritized. Otherwise, Uu UCI is prioritized.  We think we should also consider the case where PUSCH carrying SL HARQ reporting. Our proposals are:  1. If UL TX is URLLC uplink data, then URLLC uplink data is prioritized. (No piggyback as in NR Uu, no eMBB related UCI is piggybacked on URLLC uplink data)  2. Otherwise, SL HARQ reporting is piggybacked on PUSCH. |
| ZTE, Sanechips | No. PUCCH carrying SL HARQ reporting is treated as UL TX. Otherwise,   * In case there is other UL Tx overlapping, the gNB may have much smaller chance to know whether the PUCCH is transmitted or not. * In case the PUCCH is the only overlapping channel on UL, both PUCCH and PSFCH have the same priority and both are treated as SL transmission. This is a new scenario for multiple PSFCH transmission if the whole situation is not handled by UL/SL prioritization. |
| Huawei, HiSilicon | Different cases of UL Tx should be considered separately. For the case PUCCH carrying SL HARQ overlaps with PUCCH or PUSCH without UL-SCH, rule of UL/SL prioritization is applied. For the one PUCCH including SL HARQ overlaps with PUSCH with UL-SCH, the SL HARQ should be multiplexed on the PUSCH.  Another case PUSCH with SL HARQ overlaps with SL Tx should be also discussed |
| OPPO | * If PUCCH carrying SL HARQ reporting overlaps with PUSCH, we can follow option 1 in Q1; * If PUCCH carrying SL HARQ reporting overlaps with PUCCH, we can follow option 2 in Q1.   + If UE cannot decode PDSCH correctly (NACK), it cannot determine the priority or service type based on DCI only, and accordingly it cannot determine the priority of the corresponding PUCCH. A unified principle/rule should be applied here no matter UE can or cannot decode PDSCH correctly. In that case, we think option 2 is reasonable |
| CATT | Agree |
| LG | Yes. The priority of the PUCCH will be directly compared with the priority of other SL priority. |
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Q3-3: If answer to Q3 is no, what is the prioritization rule when PUCCH carrying SL HARQ reporting overlaps with SL TX and when overlaps with another UL TX?

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| Company | Answer |
| NTT DOCOMO | For collision with SL TX, our answer to Q3 is yes.  For collision with UL TX, DCI format 3\_0 includes priority indication field as DL assignment/UL grant. Based on the priority value, which transmission is prioritized is determined. |
| ZTE, Sanechips | First, the overlapping rules on Uu apply among PUCCH and another UL Tx; the winner(s) on Uu would use the highest priority of winner(s) to compete with SL Tx according to UL-SL overlapping rules. |
| Intel | Semi-static configuration per Uu priority level (“regular” or “high”) should be used to control whether Uu UCI is prioritized over SL UCI |
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Q4: For handling the case where more than one SL and UL transmissions overlap, do you agree the following proposal?

* Proposal
  + For more than one SL transmissions overlapping with a UL transmission, the highest priority of SL transmissions is used for the prioritization.
  + For more than one UL transmissions overlapping with a SL transmission, the highest priority of UL transmissions is used for the prioritization.

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| Company | Answer |
| NTT DOCOMO | Direction is OK.  One comment is, the proposal should be clarified that the assumed case is collision between SL TX and UL TX, where at least either TX or RX is more than one.  Question is saying that, while proposal does not. We believe that other case does not use the above rule. |
| Apple | Agree |
| ZTE, Sanechips | Agree. |
| Huawei, HiSilicon | Yes |
| Intel | OK |
| OPPO | Agree |
| vivo | Agree |
| CATT | Agree |
| LG | Yes.  The first case can happen when the UE transmits more than one PSFCH in a PSFCH TX occasion. Another example is that a PUSCH can be overlapped with both PSCCH/PSSCH and PSFCH in a slot.  The second case can happen when PUSCH and PUCCH are TDMed in a slot, and these UL TXs are overlapped with a single PSSCH.  To protect transmission with the highest priority, it needs to use the highest priority among the overlapped transmission for the prioritization. |

**2. Prioritization between UL TX and SL TX in case of simultaneous TXs of UL and SL across difference carriers**

Q5: Do you agree that the prioritization rule between UL TX and SL TX for power sharing reuses the prioritization rule for dropping?

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| Company | Answer |
| NTT DOCOMO | Support. |
| Apple | Agree |
| ZTE, Sanechips | Agree. |
| Huawei, HiSilicon | We agree to the extent that this is how the relative priorities are determined, e.g. to know when SL or UL (or which among each) has the higher priority. The specific power sharing behaviors are up to UE. |
| Intel | Support |
| OPPO | Agree |
| vivo | Agree |
| CATT | Agree |
| LG | Yes. There is no reason to have different prioritization rule for power sharing. |

Q5-1: If the answer to Q5 is yes, do you think the prioritization behavior for power sharing needs to be captured in the physical layer specifications for the cases where RAN2 made agreements for dropping (e.g., UL SCH and SL SCH)?

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| Company | Answer |
| NTT DOCOMO | Should be captured. |
| Apple | Agree |
| ZTE, Sanechips | Agree. |
| Huawei | No, the LS from RAN2 does not ask us to specify their agreements. RAN1 needs to specify behaviors for the cases that RAN2 did not cover. |
| OPPO | Agree |
| vivo | OK |
| CATT | Yes, we think the power sharing is for the simultaneous UL and SL transmission in different carrier case. |
| LG | We think that it needs to be captured in the physical layer specification.  At least, logical channel priority of UL-SCH needs to be available in physical layer in addition to the logical channel priority of SL-SCH which is provided by “Priority filed’ in SCI. How to describe it in details can be discussed in TP preparing phase. |

Q5-2: If the answer to Q5 is no, what is the prioritization rule for power sharing?

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