# **[100b-e-NR-5G\_V2X\_NRSL-SL\_PHY\_Procedure-03] Indicating SL HARQ feedback related information**

[100b-e-NR-5G\_V2X\_NRSL-PHY-Procedure-03] Email discussion/approval regarding indicating SL HARQ feedback related information

* How to indicate HARQ feedback Option to RX UE
* How to indicate whether SL HARQ feedback is enabled or disabled to RX UE
* Whether to support mixing blind and feedback-based retransmissions of a TB

till 4/24, with potential TPs by 4/29 (Hanbyul, LGE)

**1. How to indicate SL HARQ feedback enabling/disabling and HARQ feedback Option to RX UE**

Q1: Do you agree that at least two 2nd SCI formats are defined, one containing Zone ID and Communication range requirement and another one not containing them?

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| Company | Answer |
| NTT DOCOMO | Support. |
| Huawei, HiSilicon | We think that two 2nd SCI formats are enough. One format containing Zone ID and communication range requirement is for groupcast option 1, while the other format which does not contain them is for broadcast/unicast/groupcast option 2. |
| Apple | Agree |
| Intel | Agree to define at least two SCI formats: one contains ranging info, the other does not contain. |
| ZTE, Sanechips | Agree. |
| Futurewei | Agree |
| OPPO | Agree |
| CATT | Agree |
| LG | Yes. Since the total number of bits for Zone ID and Communication range requirement is quite large (16 bits), it would be beneficial to separate the 2nd-SCI format to reduce 2nd-SCI overhead at least for broadcast, unicast, and groupcast with non-distance based HARQ feedback. |
| Lenovo/MoTM | Yes, two 2nd SCI formats are defined one for distance based HARQ feedback and another one for the non-distance based HARQ feedback |

Q1-1: If the answer to Q1 is yes, which HARQ operation can be selected when the 2nd SCI format contains Zone ID and Communication range requirement?

- Candidates for HARQ operation: No HARQ feedback, GC HARQ feedback Option 1, GC HARQ feedback Option 2, unicast HARQ feedback

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| Company | Answer |
| NTT DOCOMO | GC HARQ feedback Option 1 only. |
| Huawei, HiSilicon | Only GC HARQ feedback for Option 1 |
| Apple | GC HARQ feedback Option 1 is associated with the 2nd SCI format contains Zone ID and Communication range requirement. |
| Intel | In these terms: No HARQ feedback, GC HARQ feedback Option 1  The HARQ operation options can be updated to the more generic:   * Blind / No HARQ feedback * Range-based + NACK-only * Range-based + ACK/NACK (for completeness, but not required) * Range-tolerant + NACK-only (for completeness, but not required) * Range-tolerant + ACK/NACK   In the updated terms: No HARQ feedback, Range-based + NACK-only, Range-based + ACK/NACK |
| ZTE, Sanechip | GC HARQ feedback Option 1 with Tx-Rx distance based operation only. |
| Futurewei | GC HARQ feedback Option 1 only. |
| OPPO | GC HARQ feedback Option 1 only. |
| CATT | GC HARQ feedback Option 1 only |
| LG | In our view, it can be used for GC HARQ feedback Option 1 only since the distance based HARQ feedback is supported only for the GC HARQ feedback Option 1.  In this case, GC HARQ feedback option indicator and HARQ feedback request indicator would not be included in this format. |
| Lenovo/MoTM | HF 1, HF 2  We don’t need to differentiate cast type. HF2 can be included in the distance based as part of future releases and completeness. However no optimization is required to be done for distance based HF2 as part of R16 |

Q1-2: If the answer to Q1 is yes, which HARQ operation can be selected when the 2nd SCI format does NOT contains Zone ID and Communication range requirement?

- Candidates for HARQ operation: No HARQ feedback, GC HARQ feedback Option 1, GC HARQ feedback Option 2, unicast HARQ feedback

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| Company | Answer |
| NTT DOCOMO | No HARQ feedback, GC HARQ feedback Option 2, unicast HARQ feedback. |
| Huawei, HiSilicon | No HARQ feedback, GC HARQ feedback Option 2, unicast HARQ feedback |
| Apple | No HARQ feedback, GC HARQ feedback Option 2 and unicast HARQ feedback |
| Intel | In the updated terms as mentioned in Q1-1: No HARQ feedback, Range-tolerant + NACK-only, Range-tolerant + ACK/NACK |
| ZTE, Sanechips | No HARQ feedback, GC HARQ feedback Option 1 w/o Tx-Rx distance based operation, GC HARQ feedback Option 2, unicast HARQ feedback |
| Futurewei | No HARQ feedback, GC HARQ feedback Option 2, unicast HARQ feedback. |
| OPPO | No HARQ feedback, GC HARQ feedback Option 1 w/o Tx-Rx distance based operation, GC HARQ feedback Option 2, unicast HARQ feedback |
| CATT | No HARQ feedback, GC HARQ feedback Option 1, GC HARQ feedback Option 2, unicast HARQ feedback |
| LG | This format can be used for No HARQ feedback, GC HARQ feedback Option 1, GC HARQ feedback Option 2, unicast HARQ feedback.  In case of GC HARQ feedback Option 1, non-distance based GC HARQ feedback can be used. When the number of PSFCH resources are not sufficient to support GC HARQ feedback Option 2, the feedback-based groupcast can be supported. When the TX UE’s location is not available, the feedback-based groupcast can be supported.  In this case, at least GC HARQ feedback option indicator needs to be present in the 2nd-SCI format without Zone ID and Communication range requirement. |
| Lenovo/MoTM | No HARQ feedback, HF 1, HF 2  We don’t need to differentiate cast type. |

Q1-3: If the answer to Q1 is yes, how many 2nd-SCI formats are defined for those with and without Zone ID and Communication range requirement? In each format, is an explicit field included to indicate whether SL HARQ feedback is enabled or disabled, and/or which option is used?

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| Company | Answer |
| NTT DOCOMO | Two: one is with zone ID and communication range requirement, another is without.  For the first one, no field is defined for feedback = enabled/disabled. No field is defined for which option is used.  For the second one, one field is defined for feedback = enabled/disabled. No field is defined for which option is used. |
| Huawei, HiSilicon | Only two 2nd SCI formats are defined and a 1 bit length explicit field in SCI format 0-1 is used to indicate which format is used.The HARQ enable/disable indication can be done by an explicit field contained in the 1st stage SCI as well. |
| Apple | Two 2nd SCI formats are defined.  For the 2nd SCI format with zone ID and communication range requirement, no explicit field is included to indicate whether SL HARQ feedback is enabled or disabled. In this case, SL HARQ feedback with GC option 1 is always enabled.  For the 2nd SCI format without zone ID and communication range requirement, explicit field is included to indicate whether SL HARQ feedback is enabled or disabled, and which feedback option is used. |
| Intel | Two formats:   * Range-based format   + Feedback enabled/disabled flag in 2nd stage SCI is present   + Optionally, NACK only, or ACK-NACK option flag can be present in 2nd stage SCI * Range-tolerant format:   + Feedback enabled/disabled flag in 2nd stage format present only if PSFCH is configured for a resource pool   Optionally, NACK only, or ACK-NACK option flag can be present in 2nd stage SCI |
| ZTE, Sanechips | Just one format for the case in Q1-1 and a second format for the case in Q1-2. The explicit enable/disable bit and HARQ feedback option bit are contained in the format w/o zone ID and range requirement, but are not contained in the format with zone ID and range requirement. |
| Futurewei | Two formats are enough: one for option 1 with range, one for the other cases of the previous question. One field indicates if HARQ feedback is enabled |
| OPPO | Two formats:   * With zone ID and range info: apply to GC HARQ feedback option 1 only; * Without zone ID and range info: apply to GC option 1, GC option 2, broadcast, unicast. Two bits is used to indicate whether feedback is enabled/disable, and to differentiate unicast and groupcast;   HARQ feedback options – 2bits:  • 00 - HARQ feedback disabled;  • 01- groupcast HARQ feedback option-1;  • 10 - groupcast HARQ feedback option-2;  • 11 - unicast HARQ feedback;  The motivation to differentiate unicast and groupcast is that the resource selection of PSFCH for unicast and groupcast is different ( where is zero for unicast, is in-group ID for groupcast). if the UE cannot differentiate unicast or groupcast, it does not how to select the resource for PSFCH. While the differentiation cannot based on destination ID. The destination ID set for unicast/groupcast/broadcast can overlap (RAN2 is discussing how to differentiate cast-type). Specific field in SCI should be used to differentiate unicast and groupcast. |
| CATT | Only two 2nd SCI formats, one is used with zone ID and communication range, another is used without zone ID and communication range.  Only in the SCI format without zone ID and communication range, one field is introduced to enable or disable SL HARQ feedback. |
| LG | We think that two 2nd-SCI formats are introduced in Rel-16 NR sidelink; One is for 2nd-SCI format with Zone ID and Communication range requirement and the other is for 2nd-SCI format without Zone ID and Communication range requirement.  Considering NR Uu link discussion, large number of DCI format size is not preferable for UE complexity. That’s why DCI format size budget is introduced in NR Uu link. Similarly, the number of SCI format size needs to be minimized as much as possible. We are supportive of introducing three SCI format sizes; one for the 1st-SCI format, two for the 2nd-SCI formats. |
| Lenovo/MoTM | Two 2nd SCI formats are defined one for distance based HARQ feedback and another one for the non-distance based HARQ feedback.  Yes, explicit SCI field in the 1st SCI indicate whether SL HARQ enable/disable.  SL HARQ feedback option 1 or 2 is signaled in the 1st SCI. If it is specified in the 2nd SCI, HF field remains unused when SL HARQ is disabled in the 1st SCI |

Q1-4: If the answer to Q1 no, do you agree that an explicit is necessary to indicate whether SL HARQ feedback is enabled or disabled, and which option is used?

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| Company | Answer |
| Huawei, HiSilicon | Enable/disable of HARQ should be a field in SCI format 0\_1. |
| Intel | Although we answered ‘yes’, we would like to provide our preference that SCI format 0-1 should not contain HARQ related information.  In this case, SCI 0-1 becomes non-forward compatible without good justification to do that. Furthermore, as SCI 0-1 was assumed to be cast-transparent, adding FB request to SCI 0-1 makes it unicast/groupcast oriented. |
| Lenovo/MoTM | SL HARQ enable/disable should be signaled in 1st SCI |
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Q2: How does the RX UE decide whether unicast HARQ feedback and GC HARQ feedback Option 2 is in use?

- Option 1: Different 2nd-SCI formats

- Option 2: Explicit indicator in 2nd-SCI

- Option 3: Using L1-destination ID

- Option 4: Others (please specify it)

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| Company | Preferred option | Comments |
| NTT DOCOMO | Option 3 | If it is difficult that PHY layer knows associations between L1 destination ID and cast-type, i.e. option 3 is not agreed, our preference is option 2 to option 1. Option 1 means larger size of 1st SCI format or less capability of future enhancement. |
| Huawei, HiSilicon | Option 3 | However, we would like to understand why this differentiation is needed: the only obvious effect is how the UE knows which PSFCH resources to use, but this is a matter of ID, rather than of unicast vs. groupcast option 2. |
| Apple | Option 2 | This can be distinguished by a flag in 2nd-SCI |
| Intel | Option 3 | In our understanding, a UE should have a-priori knowledge about group communication, since it should also obtain in-group UE ID for groupcast option 2 operation.  PHY-layer in our understanding is transparent to unicast or connection-oriented groupcast operation. |
| ZTE, Sanechips | Option 3 | May use both layer 1 destination ID and L1 source ID |
| Futurewei | Option 3 | This may be a RAN2 issue only. Not sure why L1 would need the cast type |
| OPPO | Option 2 | Destination ID cannot be used to differentiate unicast and groupcast since the destination ID set for unicast/groupcast/broadcast can overlap. SO that it is possible that the destination ID for unicast and groupcast are same. |
| CATT | Option 3-likely | From our understanding, the source ID and destination ID are known by unicast pair.  The two IDs can be used by Rx UE to determine whether unicast HARQ feedback and GC HARQ feedback Option 2 is in use |
| LG | Option 2 | First of all, we prefer to minimize the number of 2nd-SCI formats for UE complexity.  In case of L1-destination ID, it is a truncated version of L2-destination ID. When the RX UE fails to decode PSSCH, the RX UE just knows 16-bits of L1-destination ID. In this case, it would not be always possible to distinguish GC HARQ feedback Option 2 and unicast. In other words, the RX UE may not know the value of M\_ID for PSFCH transmission.  In those points of views, we are supportive of Option 2. |
| Lenovo/MoTM | Option 3 | SCI does not need to indicate cast type. Unicast can be treated like a GC with member=1 and source-destination id for unicast is already known at the RX. After decoding the L1 destination id, the RX UE knows whether it is unicast or GC either by book-keeping or by querying from higher layers. |

**2. Whether to support mixing blind and feedback-based retransmissions of a TB**

Q3: Do you think mixing blind and feedback-based retransmission of a TB (as detailed in the following) is necessary?

Q3-1: Do you think the specification needs to support the following case? If yes, what is the motivation?

- transmission of a TB in a slot indicates “HARQ feedback disabled” but retransmission of the same TB in another slot indicates “HARQ feedback enabled”

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| Company | Answer |
| NTT DOCOMO | Not necessary.  Our original preference was to support but due to time limitation, Rel-16 should not support it. |
| Huawei, HiSilicon | This does not require specific support in RAN1 specifications. MAC indicates to PHY how to (re-)transmit the TB, so RAN2 can decide whether or not MAC has the proposed function. |
| Apple | Yes. The blind retransmission reduces the TB transmission latency by not waiting for HARQ feedback. The follow-up feedback-based retransmission further increases the reliability (with efficient spectrum usage). |
| Intel | Support the mix. RAN1 can provide to RAN2 its understanding that this mode should be supported, so that RAN2 can work out necessary modifications to MAC procedures.  Blind transmission(s) followed by the feedback-based re-transmissions is the main scenario, due to the following:   * In some cases, it is desirable to first gain the minimum link budget and resolve collisions in blind mode, and then continue with FB-based for fine-tuning * In GC option 1, half-duplex collision can lead to degradation of pure FB-based mode comparing to pure blind mode. To fix it, the transmission should start from 2-3 blind retransmissions and continue with FB-based retransmissions. It was analyzed in our tdoc R1-1910650. |
| ZTE, Sanechips | No. This is not allowed by current RAN2 spec. Any revert of RAN2 spec text should be discussed in RAN2.  In addition, such operation as in Q3-1 would need to open new investigation: whether the SL feedback enabled by SCI for k-th (re)transmission of a TB should reflect only the reception for k-th transmission or all reception history so far. For example, the Rx UE successfully received the transmission up to (k-1)-th (re)transmissions whose feedback are all disabled but then failed on reception of k-th retransmission whose feedback is enabled. What is the feedback in this case? Unfortunately even this discussion of how to set feedback content may also belong to RAN2 scope. |
| Futurewei | The RAN1 specification should not prevent this possibility. |
| OPPO | Support mix mode. No specific spec is needed in RAN1. Current spec in RAN1/2 does not pre-clude this possibility. It can be left to MAC implementation. |
| CATT | Yes. We think it would be more efficient to support the service with high reliability and latency requirements. |
| LG | No, we think that once the logical channels enables SL HARQ feedback, the corresponding SCI needs to enables the SL HARQ feedback as well. With this operation, the RX UE can save the resources for PSFCH transmission for initial transmission, but the benefit is unclear since this unused resource will not be used or other purposes.  Furthermore, in case of GC HARQ feedback Option 1, such operation is not useful. For instance, a UE transmits groupcast PSSCH, the less chance of PSFCH transmission would make DTX problem worsened. For instance, if the SL HARQ feedback is disabled for initial transmission and SL HARQ feedback is enabled for retransmission, and if the RX UE fails to detect SCI scheduling retransmission, the RX UE will not transmit PSFCH and the TX UE may determine ACK for the TB. |
| Lenovo/MoTM | No, if a TB is formed from the LCH(s) containing SL HARQ disabled and later TX UE receives SL HARQ feedback, many things should be specified in the MAC HARQ protocol on how to process the feedback. Any behavior transparent to MAC can be specified for mixed mode operation or can be upto UE implementation in R16 |

Q3-2: Do you think the specification needs to support the following case? If yes, what is the motivation?

- transmission of a TB in a slot indicates “HARQ feedback enabled” but retransmission of the same TB takes place in another slot without considering the HARQ feedback corresponding to the first transmission

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| Company | Answer |
| NTT DOCOMO | Not necessary.  Our original preference was to support but due to time limitation, Rel-16 should not support it. |
| Huawei, HiSilicon | No, see Q3-1. |
| Apple | Yes, the feedback-based transmission increases the reliability with efficient spectrum usage. The follow-up blind retransmission reduces the TB transmission latency, especially when the PDB of the TB is approaching. |
| Intel | Not necessary. In our understanding, FB to blind transition cases are unjustified. |
| ZTE, Sanechips | No in RAN1 spec. Whether to consider feedback corresponding to earlier transmission(s) is in RAN2 scope. |
| Futurewei | This is not up to RAN1 to decide |
| OPPO | Not necessary |
| CATT | Not necessary |
| LG | Yes. We think this case can happen especially when more than one PSSCH slot is associated with a single PSFCH slot. For example, when two slots are determined for PSSCH transmission of a TB, it is possible that there is no PSFCH between the two slots. Such resource allocation can ensure enough number of transmissions of a TB within the given PDB. gNB can grants such resource allocation in mode 1 and the TX UE needs to perform such resource selection in mode 2 when enough retransmission is not possible within PDB. |
| Lenovo/MoTM | No, same as Q3-1 |

Q3-3: Do you think there are other cases that needs to be considered as mixing blind and feedback-based retransmissions of a TB?

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| Company | Answer |
| Huawei, HiSilicon | No, see Q3-1. |
| ZTE, Sanechips | No |
| Futurewei | No. we do not see which case(s) to support as within RAN1 scope (nor we see the need to put restrictions at the RAN1 level) |
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