# **[102-e-NR- 5G\_V2X\_NRSL-PHYprocedure-01] Email discussion/approval regarding the following aspects for HARQ operation**

[102-e-NR- 5G\_V2X\_NRSL-PHYprocedure-01] Email discussion/approval regarding the following aspects for HARQ operation

* Issue 3-1: Details of indicating groupcast HARQ feedback option
* Issue 3-2: Capturing PSFCH reception behavior in the specifications
* Issue 3-3: Exact location of PSFCH slots in the time domain

By 8/21, followed by potential TPs by 8/26 – Hanbyul (LGE)

**1. Details of indicating groupcast HARQ feedback option**

Q1: Do you support physical layer signaling to indicate groupcast with HARQ feedback Option 1 (i.e., NACK only) without distance-based feedback?

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| Company | Answer | Comment |
| NTT DOCOMO | Yes | RAN1 concluded in the last meeting that the operation is feasible from L1 signaling perspective.RAN2 agreed that the operation is supported.Based on the above two, RAN1 should support it. |
| Sharp | Yes | Same reason as NTT DOCOMO. |
| Ericsson | Yes | Due to RAN2 agreement.  |
| ZTE, Sanechips | yes | This is aligned to RAN2 agreements and RAN1 conclusion. |
| Intel | Yes | RAN1 should follow RAN2 agreement if there is no big issue (we assume no) |
| Futurewei | No | While we understand RAN2 made a decision, we think that without distance-based feedback, option 1 can create issues: it essentially implies that we support transmission with implicit ACK. Because of half duplex issues, a UE might miss a transmission, and not even be aware of it. This is always a risk with option 1, but at least the distance threshold can somehow contain it. Before having signaling for opt 1 without distance RAN1 should first discuss the cases for which opt 1 without distance should be enabled (e.g., only low priority services) |
| OPPO | Yes | Similar view as NTT DOCOMO.  |
| QC | Yes | RAN2 has reached an agreement, and RAN1 has concluded that this is feasible to support from signaling point of view. |
| CATT | Yes | RAN2 has agreed to support this operation, RAN1 should support it.  |
| NEC | Yes | Same view as NTT DoCoMo |
| Apple | Yes | To support RAN2 agreement. |
| Vivo | Yes | Align with RAN2 decision |
| Panasonic | Yes | RAN2 supports Groupcast option 1 (i.e., NACK only feedback) when Zone ID or Communication range requirement is not provided. In addition, the case of group size is greater than the number of candidate PSFCH resource is also HARQ option 1. Both should be supported in physical layer signaling. |
| Samsung | Yes | We still have concern on the performance of Option 1 without distance-based feedback. However, if RAN2 want this feature and RAN1 majority consider it as feasible, we can compromise and live with it. |
| Spreadtrum | Yes | By referring to RAN2 agreement. |
| Huawei, HiSilicon | No | RAN2, rushing at the end of the May meeting, appear to have looked at a direction that would not be good for the physical layer, if changes to PHY are made. We explained before that this what is essentially sidelink broadcast with HARQ is a new feature which has been trying to add during maintenance, and it would degrade the stability and performance of group communication in general. The remote UE may keep replying NACK due to Tx UE limited coverage, and the Tx UE may decrease the MCS and even ramp up the Tx power for better coverage. Therefore, without the reasonable distance control, GC HARQ feedback option 1 cannot work properly, it is not only related to signaling feasibility but the function of the whole feedback mechanism.On the other hand, the RAN2 agreement itself does not request any PHY change, and no LS has been received in RAN1 to activate the conditions in the RAN1 conclusion. The RAN2 agreement also does not state that groupcast option 1 must be used in the given case – only that HARQ feedback without distance-based operation is used. Therefore, we interpret that RAN2 have concluded the issue in the MAC layer, and (as per normal operation) if higher layers want a kind of non-distance based groupcast, they will give the appropriate instruction to PHY by requesting groupcast option 2 feedback. |
| LG Electroincs | Yes | According to RAN2 agreements, groupcast with HARQ feedback Option 1 (i.e., NACK only) without distance-based feedback is supported. **RAN2#110-e*** + The following additional condition is needed for HARQ option1:
		- The group size is greater than the number of candidate PSFCH resources associated with the selected PSSCH resource.
	+ For sidelink groupcast option1, TX UE can enables HARQ feedback without the distance-based operation when range configuration for sidelink logical channel or zone\_id is not (pre-)configured.

In the perspective of physical layer signalling, it is feasible to support this feature.  |
| Interdigital | Yes | Per RAN2 agreement |
| Nokia, NSB | Yes | From RAN1 point of view, there is nothing forbidding this operation of HARQ with NACK-only feedback w/o distance-based feedback. Besides, RAN2 had this agreement, indicating the RAN2 signaling support for this operation. |

Q2: If the answer to Q1 is yes, which option is used to indicate groupcast with HARQ feedback Option 1 (i.e., NACK only) without distance-based feedback?

* + Option 1: SCI format 2-A is used
		- Option 1-1: A value of Cast type indicator in SCI format 2-A is used to indicate groupcast HARQ feedback option 1 without distance-based feedback
		- Option 1-2: Additional 1-bit indicator in SCI format 2-A is introduced to indicate whether the distance-based feedback is applied or not.
	+ Option 2: SCI format 2-B is used
		- Option 2-1: Communication range requirement field in SCI format 2-B is used to indicate distance-based HARQ-ACK feedback is disabled
	+ Option 3: Others (please specify)

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| Company | Preferred option | Comment |
| NTT DOCOMO | Option 1-1 | 2-A is better since if 2-B is used, the unused overhead is not so small.Cast type indicator has a reserved state. The state can be used. Meanwhile, additional bit degrades performance. |
| Sharp | Option 2-1 | It would be better to have the “Groupcast Option 1” support in one place. |
| Ericsson | Option 1-1 | We think, it is a straightforward approach to use cast type indicator in SCI format 2-A for this purpose which avoid extra overhead which is unnecessary. |
| ZTE, Sanechips | Option 1-1 | This option is the simplest one. SCI format 2-A already contains a code-point to potentially support this.  |
| Intel | Option 2-1 orOption 1-3 (see details) | Our first preference is to keep SCI format 2-B for NACK-only operation and use a codepoint of comm range to indicate ‘no range information’The second preference is Option 1-3: to use cast type set to ‘broadcast’ AND enable feedback request.  |
| OPPO | Option 1-1 | The reserved codepoint can be used to indicate the HARQ feedback option, no necessary to introduce additional field. |
| QC | Option 2-1 | The simplest change is to keep SCI format 2-B for NACK-only operation and use a codepoint of comm range to indicate ‘no range information’. This is also a preferred option from extensibility point of view, there is currently 9 spared values for communication range in format 2-B. Option 1-1 means there is no other spared value for format 2-A, so no extension beyond R16 is possible. |
| CATT | Option 1-1 | From the overhead aspects, option 1-1 is preferred.  |
| NEC | Option 1-1 | No additional field will introduced |
| Apple | Option 2-1 | Associating “Groupcast HARQ feedback Option 1” with SCI format 2-B (distance-based or non-distance-based) makes the category clear. Also, the usage of the only reserved codepoint of “cast type indicator” in SCI format 2-A may prevent any further extension in a future release.  |
| vivo | Option 1-1 | Format 2-B has larger overhead, which is designed for distance based feedback. When there is no distance based operation, format 2-A is straightforward way.  |
| Panasonic | Option 1-1 | We think application layer connection-less group or application layer managed group can be distinguished by destination ID. To use SCI format 2-A as much as possible can minimize the signalling overhead. Therefore, we propose to take option 1-1. As the realization, reserved case in cast type indicator is used for NACK only indication would be straight forward. |
| Samsung | Option 1-1 | Using format 2-A can minimize the overhead. |
| Spreadtrum | Option 2-1 | Same reason as QC. |
| Huawei, HiSilicon | Not supported. |  |
| LG Electronics | Option 1-1 | First of all, Option 1-1 does not increase SCI overhead, and does not restrict scheduling flexibility. Next, in our understanding, according to RAN2 spec, the same setting of Zone ID and communication range requirement is used across (re)transmissions for a TB. In other words, once SCI format 2-B is used to schedule groupcast option 1 with distance-based feedback, retransmissions for the same TB can be scheduled by SCI format 2-B even though the TX UE lost its own location. In this case, Zone ID and communication range requirement used in initial transmission are also used for retransmissions.  |
| Interdigital  | Option 1-1 | The bit field and code points are already available in 2-A and using 2-A can reduce SCI-2 overhead |
| Nokia, NSB | Option 1-1, or Option 1-2 | The reserved codepoint in the reserved cast-type may be used for future purpose. 1 more bit of 2-A should be still okay for this Rel-16 design. |

**2. Capturing PSFCH reception behavior in the specifications**

Q3: Do you agree to capture UE behavior that physical layer reports HARQ-ACK information of the received PSFCH to higher layer?

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| Company | Answer | Comment |
| NTT DOCOMO | Yes | In LTE, UE receives HARQ-ACK on PHICH and it is reported to higher layer, which is captured in spec (36.213 – section 8.3).We can follow the direction; i.e. capture UE behavior of HARQ-ACK report from PHY to higher layer.In addition to Q4/Q5, report for PSFCH RX drop might be described as 16.5? |
| Sharp | Yes | In fact, we think this should be done along with restructuring the “PSFCH reception” as already captured for mode 1 in section 16.5 of 213.There are three levels of UE behaviors pertaining to PSFCH reception: (1). Determine one value for each PSFCH time/frequency/code resource; (2). Perform (1) for all PSFCH resources associated with one PSSCH transmission. (3). For mode 1 only, depending on type of HARQ-ACK codebook, for one or more of the PSSCH transmissions granted by a DCI format, perform (2) to determine one or more values to report in UL.In our view (1) and (2) are common to mode 1 and 2, and should be captured in one place (in section 16.3.1) so that a HARQ-ACK value can be determined for a PSSCH transmission, and reported to higher layers. (3) should be separately captured (i.e. in section 16.5) for mode 1).(In comparison, in the current specs, (1),(2) and (3) are messed up and are captured for mode 1 only, in section 16.5 of TS 38.213.) |
| Ericsson | Yes | We are fine with capturing it.  |
| ZTE, Sanechips | ok | We can be fine if most companies want this, although we think it is not necessary to specify this intra-UE behavior. |
| Intel | Ok |  |
| Futurewei | Yes |  |
| OPPO | Yes |  |
| QC | Yes |  |
| CATT | Yes |  |
| NEC | Yes |  |
| Apple | Yes |  |
| vivo | Yes |  |
| Samsung | Yes |  |
| Spreadtrum | Yes |  |
| Huawei, HiSilicon | Yes | It should be sufficient to have a brief, formal, sub-section in 38.213 which can refer to 16.5 without much need to duplicate the specification of what is provided to higher layers. |
| LG Electronics | Yes | According to RAN2 spec, the higher layer expects that physical layer reports SL HARQ-ACK information. |
| Interdigital | Yes | It can be captured in the section 16.3 UE procedure for reporting HARQ-ACK on sidelink of TS 38.213. The SL behavior specified should be consistent with what is specified in section 16.5 Mode 1 UE procedure for reporting HARQ-ACK on uplink |
| Nokia, NSB | Yes |  |

Q4: If the answer to Q3 yes, what is the UE behavior when SL HARQ-ACK information includes NACK-only (i.e., groupcast option 1)?

* + Option 1: UE reports NACK if the UE determines NACK from the received PSFCH. It reports ACK, otherwise.
	+ Option 2: Others (please specify)

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| Company | Preferred option | Comment |
| NTT DOCOMO | Option 2 | Reuse description of 16.5 with some update; i.e.“if the UE receives a PSFCH associated with a SCI format 2-B- report ACK when the UE determines absence of PSFCH reception for each PSFCH reception occasion from the number of PSFCH reception occasions; otherwise, report NACK” |
| Sharp | Option 1 | Wording can be resolved at TP phase. |
| Ericsson | Option 1 |  |
| ZTE, Sanechips | Option 1 | The wording can have two alternatives: * Alt-1: to put NACK determination in “if” case and ACK determination in “otherwise” case. (Option 1 as above)
* Alt-2: to put ACK determination in “if” case and NACK determination in “otherwise” case. (Option 2 from DoCoMo)

GC option-1 has signal reception for NACK only, i.e., UE should interpret an ACK reception if either it does not receive anything or something that it cannot interpret as NACK. To choose Option 1 as from FL proposal seems a better choice.  |
| Intel | Option 1 |  |
| Futurewei | Option 2 | The UE should report NACK if it receives NACK on PSFCH. If it receives nothing, it should report that “no NACK” has been received, since not receiving NACK either means implicit ACK or that the packet has not been received at all |
| OPPO | Option 1 |  |
| CATT | Option 1 |  |
| NEC | Option 1 |  |
| Apple | Option 1 |  |
| vivo | Option 1 |  |
| Samsung | Option 1 |  |
| Spreadtrum | Option 1 |  |
| Huawei, HiSilicon | Option 2 | The agreements which led to section 16.5 for reports on PUCCH/PUSCH already apply here. There is no need for new agreements. |
| LG Electronics | Option 1 | According the TS38.321, PSFCH reception behavior is not differentiated based on groupcast option as follows: 5.22.1.3.2 PSFCH receptionThe MAC entity shall for each PSSCH transmission:1> if an acknowledgement corresponding to the PSSCH transmission in clause 5.22.1.3.1a is obtained from the physical layer:2> deliver the acknowledgement to the corresponding Sidelink HARQ entity for the Sidelink process;1> else:2> deliver a negative acknowledgement to the corresponding Sidelink HARQ entity for the Sidelink process; |
| Nokia, NSB | Option 1 | Option 1 also means that when UE receives nothing, it shall report ACK. This is the general assumption for HARQ Option-1. |

Q5: If the answer to Q3 yes, what is the UE behavior when SL HARQ-ACK information includes ACK or NACK (unicast and groupcast option 2)?

* + Option 1: UE reports NACK if the UE determines NACK from the at least one received PSFCH. It reports ACK if the UE determines ACK from all the received PSFCH(s).
	+ Option 2: UE report NACK if the UE determines NACK from the at least one received PSFCH. It reports ACK if the UE determines ACK from all the received PSFCH(s). DTX is reported otherwise.
	+ Option 3: Others (please specify)

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| --- | --- | --- |
| Company | Preferred option | Comment |
| NTT DOCOMO | Option 3 | Reuse description of 16.5 with some update; |
| Sharp | Option 1 | Wording can be resolved at TP phase. |
| Ericsson | Option 1 | We believe that we don’t have to capture DTX signaling.  |
| ZTE, Sanechips | Option 1 | DTX reporting is not necessary according to 38.321 (copied below). It is strange to report DTX for a groupcast option 2 process.------------------------------the following is only for unicast----------- 1> if PSFCH reception is absent on the PSFCH reception occasion:2> increment *numConsecutiveDTX*;--------------------------------------------------------------------------------------- |
| Intel | Option 1 |  |
| Futurewei | Option 1 |  |
| OPPO | Option 3 | We have discussed how to report HARQ-ACK on uplink in 16.5. We can reuse them with necessary update.At least, the option 1 and option 2 are not correct in my view. In both options, the following modification is necessary: “ It reports ACK if the UE determines ACK from all the ~~received~~ expected PSFCH(s)” |
| QC | Option 3 | UE reports ACK if both of the 2 following conditions are met “the UE determines ACK from all the received PSFCH(s) *and UE determines no NACK from all the received PSFCH”.* UE reports NACK otherwise. |
| CATT | Option 3 | From our understanding, the behavior of unicast could be different from that of groupcast option 2. For example, in Groupcast option 2, the DTX is similar as that of NACK, no need to introduce DTX in groupcast.However, in unicast, the DTX is used for RLF management in RAN2.  |
| NEC | Option 1 |  |
| Apple | Option 1 | We do not need a separate DTX reporting.  |
| vivo | Option 1 | Do not need to report DTX as explained by ZTE.  |
| Samsung | Option 3 | Similar view as OPPO. We can reuse the description in 16.5. Current option 1/2 are not accurate. |
| Spreadtrum | Option 1 | DTX could be indirectly indicated by not reporting ACK or NACK. |
| Huawei, HiSilicon | Option 3 | The agreements which led to section 16.5 for reports on PUCCH/PUSCH apply here. There is no need for new agreements. |
| LG | Option 1 | According to RAN2 spec [5.22.1.3.3, TS38.321], the higher layer also considers the absence of PSFCH reception as follows: The Sidelink HARQ Entity shall for each PSFCH reception occasion associated to the PSSCH transmission:1> if PSFCH reception is absent on the PSFCH reception occasion:2> increment *numConsecutiveDTX*;Considering that physical layer always reports HARQ-ACK information when the UE determines ACK or NACK, DTX reporting is not necessary.  |
| Interdigital | Option 2 | There are cases that a UE may not attempt to decode PSFCH due to intra-UE prioritization and the MAC doesn’t know whether PSFCH is missing or the PHY didn’t attempt to decode it. Therefore, it would be better PHY indicate DTX to upper layer only when the UE decode the PSFCH but no PSFCH is detected  |
|  |  |  |
| Nokia, NSB | Option 1 | No need for DTX reporting for HAR |

**3. Exact location of PSFCH slots in the time domain**

Q6: Which options is used to define PSFCH slot location in a resource pool when PSFCH resource period is N,

* + Option 1: Logical slot index #0, #N, #2N, …. within 10240 ms period
	+ Option 2: Logical slot index #N-1, #2N-1, #3N-1, … within 10240 ms period
	+ Option 3: Logical slot index …, #M-2N, #M-N, #M within 10240 ms period, where logical slot #M is the last slot of a resource pool
	+ Option 4: Others (please specify)

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| Company | Preferred option | Comment |
| NTT DOCOMO | Option 1, orOption 2 |  |
| Sharp | Option 4 | No strong opinion on Option 1/2/3, but we think *MinTimeGapPSFCH* should also be taken into account. |
| Ericsson  | Option 3 | In our view, option 1 and option 3 are similar in the sense that either the first slot (Option 1) or the last slot (Option 3) is always a PSFCH slot. However, Option 3 provides the following additional benefits compared to Option 1:* Less wasteful of resources, because the PSFCH resources in first slot is useless since it cannot be used (due to *MinTimeGapPSFCH*.)
* Option 3 always results in the least number of dangling/orphan slots at the end of the resource period/pool which cannot be used for HARQ feedback based transmissions. This is also an advantage compared to Option 2.
* Option 3 does not require truncating the resource pool period to be a multiple of N.

The MinTimGapPSFCH can be further taken into account in Option 3 by skipping the PSFCH slot that has index smaller than MinTimeGap PSFCH.  |
| ZTE, Sanechips | Option 1 | Option 1 can avoid so-called ‘orphan’ PSSCH slots. Option 3 is technically the same as option 1, but option 1 is simpler. |
| Intel | Option 3 | On the resource pool border there will be no issue of mapping of more than N PSSCH slots to one PSFCH occasion |
| Futurewei | Option 1 | We can also accept option 2 as second preference |
| OPPO | Option 1 or Option 2 |  |
| QC | Option 2 | This is the simplest solution. There is also no issue of mapping more than N PSSCH slots to one PSFCH occasion, given this is a rare occasion. |
| CATT | Option 1 | Option 1 is more simple to avoid “orphan” PSSCH slots.  |
| NEC | Option 2 | MinTimGapPSFCH may always cause 'orphan' PSSCH/PSCCH slots in one resource pool period. Coordination with next resource pool should be discussed. |
| Apple | Option 2 or Option 3 | Option 1 seems to always have waste on the first PSFCH slot.  |
| vivo | Option 1  | Option 1 and option 3 are similar, both can avoid to map more than N PSSCH slots to one PSFCH occasion. Since we do not see technical benefit one over the other, we would like pick a simple way. |
| Panasonic | Option 2 |  |
| Samsung | Option 1 | We can also accept Option 2. |
| Spreadtrum | Option 2 or option 3 | As PSFCH resource on logical slot index #0 in option 1 will not be used. |
| Huawei, HiSilicon | Option 2 | Because the PSFCH configuration may be different for the two adjacent resource pools, supporting inter-period HARQ feedback will introduce PSFCH collision. Thus in order to maximize utilization of the first PSFCH slot, option 2 is the best choice. |
| LG Electronics | Option 1 | Option 1 has the benefit of ensuring that the number of PSSCH slots associated with the same PSFCH occasion is not be greater than the PSFCH resource period if RAN1 allows a case where the number of logical slots in a resource pool is NOT a multiple of PSFCH resource period. On the other hand, Option 2 may be problematic since the number of PSSCH slots associated with the same PSFCH occasion can be greater than the PSFCH resource period and the specification does not specify PSSCH-to-PSFCH associated for this case. If RAN1 agrees to have a restriction that the number of logical slots in a resource pool is a multiple of PSFCH resource period, Option 2 and 3 do not give technical difference.Depending on the packet arrival time or first PSCCH/PSSCH transmission time, we cannot say that which option is better in terms of PSFCH resource utilization or latency. Moreover, considering that the PSFCH slot patterns will be repeated across 10240 ms periods, these options do not give technical or benefit difference. Note that according to agreement and the latest version of TS38.213, PSSCH-to-PSFCH association could be across different SFN/DFN periods as shown in following figure (10 logical slots in a resource pool within 10240ms period, 4 slots of PSFCH resource period, K=3). At that time, Option 3 could be seen as shifted version of Option 1 as follows: Meanwhile, in the perspective spec writing, Option 1 is very simple since it does not needs to consider how many slots belong to a resource pool, or what is PSFCH resource period.  |
| Interdigital | Option 3 | Option 3 can avoid both “orphan” slot and doesn’t put constraint on the number of logical slots being a multiple of N.  |
| Nokia, NSB | Option 1 or Option 3 |  |

Q7: Do you think the number of logical slots of a resource pool is always a multiple of N, the PSFCH resource period?

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| Company | Answer | Comment |
| NTT DOCOMO | Yes | Otherwise, some PSSCH resources would not be associated with PSFCH resources, according to Q6 and the current specification. To solve this issue, further discussion would be necessary, which is not good way in maintenance phase. |
| Sharp | Yes | If this is not the case, for a given resource pool, some of the PSSCH transmissions have associated PSFCH resources while others don’t have. Exceptions have to be identified and fixed one by one in the specs (including in RAN2 specs) e.g. for the cases where a selected/granted resource may not have associated PSFCH resource etc. |
| Ericsson | No | We don’t think that such restriction on the configuration is necessary. See also our response to Q6.  |
| ZTE, Sanechips | Depending on conclusion from Q6.  | If option 1 or option 3 in Q6 is agreed, it is not necessary to have this restriction. If option 2 was agreed in Q6, we prefer to have this restriction to avoid ‘orphan’ slots. Q6/Q7 could be merged into one discussion.  |
| Intel | No | Given the answer to Q6, it is an unnecessary restriction |
| Futurewei | Yes | We agree that it does not strictly have to be the case. For example, on some slots, there could only be transmissions with no associated PSFCH. However, having the number of logical slots as a multiple of N is not a strong restriction and can simplify the system |
| OPPO | No | Firstly, we need to clarify “the number of logical slots of a resource pool”. How to define the number of the logical slots of a RP? The slots of a RP is repeated in the time domain. Once it is configured, the logical slots of the RP will repeat in time domain until it is re-configured. There is no obvious stating time and ending time of the RP.  |
| QC | Yes | This will simplify the procedure a lot.  |
| CATT | Yes | It could simplify the system |
| NEC | Depending on Q6 |  |
| Apple | Yes | This simplifies the design. |
| Vivo | No | Firstly, we do not see a problem when a resource pool is notmultiple of N, each PSSCH slots will correspond to a PSFCH occasion if option 1/3 in Q6 is adopted.Secondly, such restriction may sacrifice the pool configuration flexibility. |
| Panasonic | No | SL enabling slots should be usable. If some slot should not be (pre-)configured in the resource pool, it wastes SL slots in every resource pool period. The last X slots where X is"(the number of SL slots in a resource pool) mod (the period of PSFCH resource)", could be orphan slots. Rx UE doesn’t transmit PSFCH corresponding to PSSCH on orphan slots. |
| Samsung | No | It depends on the conclusion of Q6. If the orphan PSFCH slot issue can be solved, it’s unnecessary to introduce such a restriction. |
| Spreadtrum | No | It depends on Q6. |
| Huawei, HiSilicon | No | The orphan slots in the last of resource pool always exist, no matter it isa multiple of N or not. Since the minimum time GAP =2 or 3 |
| LG Electronics | Yes | It will make any potential issue due to the imbalance of PSSCH-to-PSFCH mapping simple.  |
| Interdigital | No | The constraint is not necessary if option 1 or option 3 in Q6 is selected.  |
| Nokia, NSB | Yes | This is the simplest design. |
|  |  |  |

**Proposal set #1**

Proposal 1

* HARQ feedback Option 1 (i.e., NACK only) without distance-based feedback is supported from the physical layer perspective.
	+ A value of Cast type indicator in SCI format 2-A is used to indicate groupcast HARQ feedback option 1 without distance-based feedback

FL’s note:

* This is based on the majority view as well as support for the RAN2 agreement. As RAN2 agreed that HARQ option 1 is selected when the group size is larger than the associated PSFCH resource number, not supporting this signaling would mean that the TB cannot be transmitted when the groupcast packet size increases.

Proposal 2

* Prepare a TP to capture UE behavior that physical layer reports HARQ-ACK information of the received PSFCH to higher layer. Detailed wording will be discussed during the TP phase (including the alignment with Section 16.5 of 38.213) with the following principle:
	+ SL HARQ-ACK information includes NACK-only: UE reports NACK if the UE determines NACK from the received PSFCH. It reports ACK, otherwise.
	+ SL HARQ-ACK information includes ACK or NACK: UE reports NACK if the UE determines NACK from the at least one received PSFCH. It reports ACK if the UE determines ACK from all the received PSFCH(s).

FL’s note:

* Some companies responded that the wording in Section 16.5 should be reused, but the FL thinks that the same wording is not possible in some cases. Especially in unicast, 16.5 describes that absence of PSFCH is treated as NACK while the MAC procedure agreed in RAN2 includes sidelink RLM based on the absence of PSFCH.

Proposal 3

* Prepare a TP to define the logical slot index of a resource pool.
	+ The wording in LTE V2X is the baseline and details will be discussed during the TP phase.
* When the PSFCH resource period is N, PSFCH slot is located in
	+ Option 1: Logical slot index #0, #N, #2N, …. within 10240 ms period
	+ Option 3: Logical slot index …, #M-2N, #M-N, #M within 10240 ms period, where logical slot #M is the last slot of a resource pool

FL’s note:

* The FL recognized that the logical slot index is not clearly defined in the current spec. Without this, discussion of the options would be unclear. The first bullet is based on this observation.
* Some companies mentioned the issue of “unused PSFCH slots” but the FL thinks that any PSFCH slot is associated with a number of PSSCH slots by the agreements as well as by the current spec. The real issue is the imbalance of the number of PSSCH slots associated with a particular PSFCH slot if the answer to Q7 is no.
* As illustrated in the figure in LGE’s response (note that SL HARQ feedback association may cross the 10240 ms window), Option 1 and 3 are effectively the same in FL’s understanding. One PSFCH slot within 10240 ms period may be associated with less than N PSSCH slots. In this case, some PSFCH resources are not going to be used, but FL thinks that the system can still operate in the current spec.
* Option 2 seems problematic as one PSFCH slot may be associated with more than N PSSCH slots and some further operation may need to be introduced as several companies mentioned. The FL proposes not to consider this.
* If the group can agree to “yes” to Q7, FL thinks that any of the three options are the same and the selection should be simple, e.g., by the majority view.
* If the group cannot agree to “yes” to Q7 (which is the case FL assumed in this proposal), the FL thinks that Option 2 needs to be excluded and a simple selection needs to be made between Option 1 and Option 3. Still in this case, the FL thinks that no further solutions should be considered to handle the non-multiple case; if there are substantial additional work, the group should take the restriction asked in Q7.

**Proposal set #2**

Proposal 1

* HARQ feedback Option 1 (i.e., NACK only) without distance-based feedback is supported from the physical layer perspective.
	+ A value of Cast type indicator in SCI format 2-A is used to indicate groupcast HARQ feedback option 1 without distance-based feedback

Proposal 2

* Prepare a TP to capture UE behavior that physical layer reports HARQ-ACK information of the received PSFCH to higher layer. Detailed wording will be discussed during the TP phase with the following principle:
	+ Groupcast option 1: UE reports ACK when the UE determines absence of PSFCH reception for the PSFCH reception occasion; otherwise, reports NACK.
	+ Groupcast option 2: UE reports ACK if the UE determines ACK in PSFCH resources corresponding to every identity M\_ID of the UEs that the UE expects to receive the PSSCH, as described in Clause 16.3; otherwise reports NACK;
	+ Unicast: UE reports HARQ-ACK information with same value as a value of HARQ-ACK information the UE determines from the PSFCH reception

Proposal 3

* Prepare a TP to define the logical slot index of a resource pool.
	+ The wording in LTE V2X is the baseline and details will be discussed during the TP phase.
* The number of logical slots of a resource pool, counted within 10240 ms period, is always a multiple of the PSFCH resource period.
	+ Note that this is already implied by the current specifications.
* When the PSFCH resource period is N, PSFCH slot is located in (one option is to be down selected)
	+ Option 1: Logical slot index #0, #N, #2N, …. within 10240 ms period
	+ Option 2: Logical slot index #N-1, #2N-1, #3N-1, … within 10240 ms period

**Proposal set #3**

Proposal 1

* HARQ feedback Option 1 (i.e., NACK only) without distance-based feedback is supported from the physical layer perspective.
	+ A value of Cast type indicator in SCI format 2-A is used to indicate groupcast HARQ feedback option 1 without distance-based feedback

Proposal 2

* Prepare a TP to capture UE behavior that physical layer reports HARQ-ACK information of the received PSFCH to higher layer. Detailed wording will be discussed during the TP phase with the following principle:
	+ Groupcast option 1: UE reports ACK when the UE determines absence of PSFCH reception for the PSFCH reception occasion; otherwise, reports NACK.
	+ Groupcast option 2: UE reports ACK if the UE determines ACK in PSFCH resources corresponding to every identity M\_ID of the UEs that the UE expects to receive the PSSCH, as described in Clause 16.3; otherwise reports NACK;
	+ Unicast: UE reports HARQ-ACK information with same value as a value of HARQ-ACK information the UE determines from the PSFCH reception

Proposal 3

* Prepare a TP to define the logical slot index of a resource pool.
	+ The wording in LTE V2X is the baseline and details will be discussed during the TP phase.
* The number of logical slots of a resource pool, counted within 10240 ms period, is always a multiple of the PSFCH resource period.
	+ No specification impact is expected for this.
* When the PSFCH resource period is N, PSFCH slot is located in (one option is to be down selected)
	+ Option 1: Logical slot index #0, #N, #2N, …. within 10240 ms period
	+ Option 2: Logical slot index #N-1, #2N-1, #3N-1, … within 10240 ms period

**Company input on the remaining parts of Proposal 3:**

Q1: Do you agree with the following proposal?

* The number of logical slots of a resource pool, counted within 10240 ms period, is always a multiple of the PSFCH resource period.
	+ No specification impact is expected for this.

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| Company | Answer | Comments |
| LGE | Yes | As discussed in the reflector, being deviated from this proposal results in an operation not aligned with the existing agreements. Such an operation shouldn’t be the discussion target in this phase. |
| NTT DOCOMO | Yes | Current phase is CR. Further discussion should be avoided when current spec aligned with previous agreements works well and huge issue is not found.  |
| Sharp | Yes | Same view as LGE and DCM. |
| NEC | Yes | This is to ensure the PSFCH slot appears periodically per resource pool (not per period) and PSFCH slots are aligned between different UEs which applying resource pool configuration at different periods.  |
| Spreadtrum | Yes | This simplifies the issue at current phase. |
| Ericsson | No | We do not think this restriction is needed. The current specs already support both “balanced” and “imbalanced” operations (i.e., both in the case the interval between two consecutive PSFCH slots is N slots and less than N slots), **no specs change is needed**(please see our example in response to Luo Chao’s question in the email discussion). Hence, restricting to only the “balanced” case is both unnecessary and undesired (e.g., it limits the flexibility on gNB side with an extra computational cost.). |
| vivo | No | Same view as E///. By the way, why there is not spec. change by supporting the proposal? Spec. should define such restriction. If there is not spec. change, it means spec. allows the ‘imbalance’. |
| Panasonic | Yes | We think “imbalanced association” should be allowed to improve resource utilization. However as discussed in e-mail, the agreement in RAN1#96b is “It is supported, in a resource pool, that within the slots associated with the resource pool, PSFCH resources can be (pre)configured periodically with a period of N slot(s)” . We are fine with proposal without further enhancement. |
| Samsung | No | Same view as E/// and vivo. It’s unnecessary restriction for gNB scheduling flexibility. In addition, we also cannot understand why no specification impact is needed for the proposal. For example, we made an agreement in RAN1#100 as follows:Agreements:* Physical layer assumes that rbSetPSFCH is always form of a multiple of numSubchannel\*periodPSFCHresource.

Then it’s reflected by 38.213 as:...The UE expects that $M\_{PRB, set}^{PSFCH}$ is a multiple of $N\_{subch}∙N\_{PSSCH}^{PSFCH}$.Similarly, if the proposal above is agreed, some spec work is necessary. |
| Huawei, HiSilicon | No | Actually, we do not see current spec implies the number of logical slots within a resource pool is always a multiple of the PSFCH resource period. Base on the section 16.3, it says:  “a number of $N\_{PSSCH}^{PSFCH}$ PSSCH slots associated with a PSFCH slot…”which specifics PSSCH slots derived by PSFCH slot, but this does preclude the PSSCHs slot which correspond to two PSFCH slots have overlapping. Just take a simple instance, k=2 and N=4, for simplicity, there are 11 slots in a 10240ms period and option 1 is adopted. Shown in the below figure, PSFCH 2 in last period corresponds PSSCH slots 3,4,5,6 and PSFCH 0 in next period corresponds to PSSCH slots 6,7,8,9 so the PSSCH in slot 6 could map to both PSFCH 2 in previous period and PSFCH 0 in the next period, but based on the k (mini time gap) requirement and the principle of selecting first slot includes PSFCH resource, PSFCH2 is chosen without doubt at last. Therefore, the current spec works properly and we do not think it is necessary to have this restriction. |
| CATT | Yes | We support the proposal. The proper system configuration can resolve the imbalance issue in a simple way, and also the maximum overhead is 3 slots in 10240ms, which is not a big issue. |
| Qualcomm | See comment | Given the comments that this could cause signficant increase in gNB complexity, we're ok with not having the restriction.  |

Q2: Do you agree that a PSFCH slot can be associated with PSSCH slots in the previous 10240 ms period?

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| Company | Answer | Comments |
| LGE | Yes | The existing agreements and spec text make the association without limitation w.r.t. the 10240 ms period. |
| NTT DOCOMO | Yes | Otherwise, some PSSCH slots do not have corresponding PSFCH occasion. Such assumption is not aligned with previous agreements. Periodic reservation, aperiodic reservation, etc. do not consider boundary of resource pool period. Cleary the same direction supports the same direction. |
| Sharp | Yes | In our understanding this is the case in all other places of the specs, in the sense that when we say HARQ-ACK in slot n+k corresponding to data in slot n, it holds regardless of whether there is a SFN wrap-around in between. |
| NEC | Yes | The associated agreements is within one resource pool which could contain multiple 10240ms periods. |
| Spreadtrum | Yes | This can enable the PSSCH slots at the end of previous 10240ms have corresponding PSFCH. |
| Ericsson | Yes  | We do not see any issue with this (concept-wise and specs-wise), and we are willing to accept it as a part of the whole package. Strictly speaking we do not have such an agreement.  |
| vivo | Yes |  |
| Panasonic | Yes | In our understanding, the meaning of “the UE provides the HARQ-ACK information in a PSFCH transmission in the resource pool” in 38.213 is just resource pool, PSFCH can be transmitted across the resource pool periods. |
| Samsung | Yes | It shows no contradiction with current specification and agreements, and is a natural way to enhance resource efficiency. |
| Huawei, HiSilicon | Yes | If not supported, the last $(M-\left⌊{M}/{N}\right⌋∙N+k)$ slots cannot be used. |
| CATT | Yes | This is similar as that in LTE V2X |
| QC | Yes | It’s is crucial to support this |

Q3: What is your preference on the option of PSFCH slot determination? Please elaborate how your preference renders technical difference from the others.

* + Option 1: Logical slot index #0, #N, #2N, …. within 10240 ms period
	+ Option 2: Logical slot index #N-1, #2N-1, #3N-1, … within 10240 ms period
	+ Option 3: Logical slot index …, #M-2N, #M-N, #M within 10240 ms period, where logical slot #M is the last slot of a resource pool

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| Company | Answer | Comments |
| LGE | Option 1 | If the answer to Q1 and Q2 are both yes, no technical difference is observed from Option 2 so Option 2 is also okay. Option 2 and 3 are equivalent if the answer to Q1 is yes. If the answer to Q2 is yes, Option 1 and 3 are the same in terms of HARQ association and no technical difference is observed. |
| NTT DOCOMO | Option 1 | Option 1 is the simplest one.- If Q1 is YES, the three options are same. Some company mentioned benefit in terms of ‘SUPER’ initial slot of the resource pool, but no need to consider the ‘SUPER’ initial slot. Another note is that resource pool timing, i.e. PSFCH timing shall be aligned with any UEs.- Even if answer for Q1 is NO, there is no difference between option 1 and option 3. Option 2 leads to ‘orphan’ slot, which is undesirable. |
| Sharp | Option 1 | We don’t see any difference between these options in terms of technical pros and cons, and thus the simplest one should be chosen. |
| NEC | Option 2 | As we gave YES to Q1 and Q2, option 2 and option 3 are equivalent. We prefer option 2 wording because the applying from the very last slot seems a litter strange. There is a shift between option 1 and option 2 considering multiple periods within a resource pool, but considering one period only, we think option 2 is more straightforward to avoid orphan slots at the boundary of a period.  |
| Spreadtrum | Option 2 | We agree that the three options are equivalent with answer yes to Q1 and Q2, except the Logical slot index #0 in the 1st 10240ms of a resource pool. Considering that it has no corresponding PSSCH, we prefer to option 2. |
| Ericsson | Option 3 | Since our answer to Q1 is No, we see some issues with O2 (namely, it can lead to the distance between two consecutive PSFCH slots to be larger than N). As pointed out several times in our inputs to the FL summary and in the email discussion, O3 has several technical advantages over O1. We have not seen any evidence of technical advantage of O1 over O3. Also, we believe that O3 carries both advantages of O1 (allows inter-period HARQ feedback without limiting a period to be multiple of N) and of O2 (no dangling PSSCH slots). So O3 should be the natural choice. |
| vivo | Option 1/2 | Option 1/2 are simple and equivalent definition. M needs to be clarified in option 3 |
| Panasonic | Option 1or 2 | If Q1 and Q2 are yes. There is no difference. |
| Samsung | Option 1 | We consider the performance of total 3 options are quite similar. Option 3 seems more complicated on calculation of PSFCH slots thus not preferred by us. If the answer of Q1 and Q2 are both Yes, we can also accept Option 2. |
| Huawei, HiSilicon | FFS, up to the output of Q1/Q2 | We do not have strong preference here, but we think the decision is highly related to the output of Q1/Q2, we can converge the discussion of Q1/Q2 and then come back the dedicated solution.  |
| CATT | Option 1 | Both option 1 and option 2 are similar and fine for us. We can follow majority views for option 1 and option 2.  |
| QC | Option 3/1 | When the number of logical slots of a resource pool, counted within 10240 ms period, is not a multiple of the PSFCH resource period, the gap between the 2 consecutive PSFCH slots at the period boundary is larger than numPSFCH gap. The current formula to map PSSCH resource to PSFCH resource in frequency domain does not work any more (time mapping still works as pointed out by Ericson). In particular, 1. Current formula requires 0 <= i < numPSFCHgap
2. If the condition is relaxed, there will be more PSFCH resource collision due to i index overflow at numPSFCHgap
3. At the upper edge, this overflow may lead to some PSFCH resources that are out of configured pool. This is a clear violation of the agreement that PSFCH and PSSCH transmissions must be on the same resource pool.

Neither Option 3 nor Option 1 have this issue and we are OK with either.On the other hand, it seems ambiguous how index i is derived based on slot index. Hopefully we can clarify this point in the same TP. |