3GPP TSG RAN WG1 Meeting #102-e R1-200xxxx

eMeeting, August 17 – 28, 2020

Agenda Item: 7.2.4.2.1

Source: Moderator (Ericsson)

Title: Resource allocation for NR sidelink Mode 1 – Thread 1

Document for: Discussion, Decision

# 1 List of issues for discussion

[102-e-NR-5G\_V2X\_NRSL-Mode-1-01] Email discussion/approval covering:

* Remaining issues for configured grant
	+ Whether clarifications for the formula determining the granted slots are necessary and whether the issue should be left to RAN2.
	+ Clarifications on signalling for number of retransmissions
	+ Editorial corrections and clarifications for configured grant (if any).
* DCI aspects
	+ Alignment of DCI format 3\_0 with other DCI formats.
	+ Cells on which the UE monitors DCI formats 3\_0 and 3\_1, including discussion on PUCCH cell.
	+ Editorial corrections and clarifications for DCI (if any).

By 8/20, followed by potential TPs by 8/25 – Ricardo (Ericsson)

# Discussion

## 1.1 Remaining issues for configured grant

### Issue 1.1-1 Clarifications on the formula for determining the granted slots

**Regarding the formula for determining the granted slots for a configured grant:**

1. **A correction is necessary (please provide details in your reply).**
2. **No correction is necessary in RAN1 (Note: RAN2 can determine whether a correction is necessary and apply it.)**

**FL summary (19/8/2020):**

* A substantial number of companies have expressed concerns with the current formula.
* The majority of companies propose to leave the discussion to RAN2.
* Given that this is captured in the RAN2 specifications and that RAN1 cannot agree a CR, my proposal is to leave this to RAN2.

**FL summary (20/8/2020 and 24/8/2020):**

* No changes in the positions. The proposed conclusion remains the same.

**Proposed conclusion:**

* Corrections to the formula for determining the slots granted by a configured grant will be handled by RAN2.

**(For other answers, please explain)**

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| **Company** | **View** |
| Intel | B (tentative)We are not yet aware of any corrections needed from RAN1 perspective. We are open to consider corrections if companies can highlight the issues. |
| OPPO | A.1. *numberOfSLSlotsPerFrame* is not a constant value per frame. How many slots per 10ms can be used for SL is determined by TDD-UL-DL-ConfigCommon, which can configure two patterns within 20ms. The number of UL slot per 10ms is independently configurable.2. The slot determined by the formula may not belong to the resource pool that the configured grant is associated to. Some specification is needed to specify how to deal with that case.  |
| vivo | A.Same view as OPPO. *numberOfSLSlotsPerFrame* which represents the number of logical slots in a frame is not matched with 20ms in the conversion formula. And the CG resources determined based on the formula may be outside the corresponding pool as the period converted on top of the conversion formula is not dependent on pool configuration.[vivo-2020/08/20]I'm wondering if RAN2 can handle this, given that they don't know much about the difference between logical and physical resources, nor the details of period conversion formula. I suggest that this issue be discussed in RAN1 first. |
| LG Electronics | We are open that the necessary correction, if any, is resolved by RAN2. |
| ZTE, Sanechips | B.We agree RAN2’s interpretation (in 38.321, sec. 5.8.3) of “*numberOfSLSlotsPerFrame*” as number of logical slots per frame is problematic. However, this parameter is not used in RAN1 spec 38.214. So unless RAN1 spec contains certain UE behaviors depending on this parameter, the correction should be discussed in RAN2. |
| Apple | B. We think the issue can be discussed and addressed in RAN2.  |
| Sharp | A.As discussed in our contribution, the item “numberOfSLSlotsPerFrame” is not a constant if two patterns with both periodicities as 10ms in tdd-UL-DL-ConfigurationCommon are configured with different number of UL slots. In RAN1#101e, it was agreed to use logical slots in determining resources of CG type 1 and the conversion from physical time duration P\_rsvpTX to logical slots is decided by RAN1. Thus, from our perspective, it is better to address the issue on logical slots in RAN1.Since the item “N” which denotes the number of SL slots within 20ms has already been specified in 8.1.7, TS38.214, and P+P2 is always divided by 20ms, we propose to use “N” instead of “numberOfSLSlotsPerFrame” in the formula and please find the details of change as follows,After a sidelink grant is configured for a configured grant Type 1, the MAC entity shall consider sequentially that the first slot of the Sth sidelink grant occurs in the logical slot for which:[($\left⌊SFN\right⌋$ × N) + logical slot number in the two consecutive frames] = ($\left⌊timeReferenceSFN\right⌋$ × N +$N\_{extra}$+ sl-TimeOffsetCGType1+ S × PeriodicitySL) modulo (512 × N).where $PeriodicitySL=\left⌈\frac{N}{20 ms}×sl\\_periodCG\right⌉$, and *N* refers to the number of logical slots that can be used for SL transmsission in 20ms, as specified in clause 8.1.7 of TS 38.214 [7]. The first frame of the two consecutive frames is an even frame. If $timeReferenceSFN$ is an even frame, $N\_{extra}=0$; Otherwise, $N\_{extra}$ refers to the number of logical slots that can be used for SL transmission in an even frame.[Sharp\_2]Based on the observations from RAN2 as captured in R2-2008112 by LGE, the issue raised by OPPO in R2-2006769 related to resource determination of SL configured grant was based on RAN1 agreement and should be discussed in RAN1. Thus, we propose to discuss it in RAN1. |
| CMCC | Similar view with OPPO that the“numberOfSLSlotsPerFrame” is problematic when dual patterns are configured. We are ok to address it in RAN1 or RAN2. |
| CATT | A.Same view with OPPO and vivo. But The correction can be done by RAN2 based on RAN1’s agreements. |
| Huawei, HiSilicon | B.As the determination of configured grant slot are specified in 38.321, we think it can be further discussed and corrected in RAN2 if there is problem. |
| Samsung | B.We have similar view with ZTE that the interpretation of “*numberOfSLSlotsPerFrame*” may be problematic but should be fixed by RAN2, since the parameter is not present in RAN1 specifications. |
| Ericsson | B. If there is any issue, it should be RAN2 solving it. |
| Nokia, NSB | B.The current text in 38.321 is problematic, as pointed out by OPPO and others, but this can be fixed by RAN2. |
| Futurewei | B. Up to RAN2 to correct, if needed |
| Spreadtrum | We share similar view that “numberOfSLSlotsPerFrame” is problematic and we are fine to solve it either in RAN 1 or RAN 2.  |

### Issue 1.1-2 Clarifications on signalling the number of retransmissions

**A few contributions discuss how to signal the number of retransmissions in Mode 1 and set the corresponding TDRA and FDRA fields in SCI (e.g., R1-2005797, R1-2006434). This does not seem to be covered in the specification, which currently refers only to Mode 2 (see TS 38.213, Clause 16.4).**

**For Mode-1, the following two agreements determine how to set the TDRA and FDRA fields in DCI/SCI.**

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| Agreements:* For dynamic grant, DCI indicates the time-frequency resource allocation with the signalling format used for SCI.
	+ In addition, the starting sub-channel for initial transmission is signalled in DCI.

Agreements:* At least the following parameters are part of a SL configured grant configuration:
	+ Configuration index of the CG
	+ Time offset (for type-1 only)
	+ Time-frequency allocation (for type-1 only)
		- Using the same format as in DCI.
	+ Periodicity
	+ The configured grant is associated with a single transmit resource pool.
	+ RAN2 can add other parameters if deemed necessary by RAN2
* A UE in mode 1 is configured at least with one transmit resource pool
* For type-2 CG, the time-frequency allocation and the configuration index of the CG are indicated in DCI.
	+ All parameters for CG type 2 for activation DCI re-use the same respective parameters configured for CG type 1, when applicable
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**FL summary (19/8/2020):**

* The proposal is widely supported. Some replies have pointed out the need to treat differently the first and subsequent transmissions.
	+ For DG, it is straightforward. SCI in Resource1 points to Resource2 and Resource3 (if granted), as signalled in DCI. SCI in Resource 2 points to Resource3 (if granted).
	+ For CG, the principle is the same but the signalling has to be constrained to a single period. In general, signalling across periods is not possible using TDRA and FDRA.
* Based on this, I have updated the proposal as follows:

**FL summary (20/8/2020):**

* The proposal is widely supported but there were a couple of comments requesting to correct the value of FDRA.
* Based on this, I have updated the proposal as follows:

**Proposal:**

* Capture how to set the TDRA and FRDA fields in the specification based on the above agreements:
	+ For the SCI transmitted in the first granted resource (for DG) or in the first resource in a period (for CG), the values of TDRA and FDRA are the ones provided in DCI.
	+ For the SCI transmitted in the second granted resource (for DG) or in the second resource in a period (for CG), the values of TDRA and FDRA indicate the second and third granted resources (for DG) or the second and third resources in a period (for CG). If the grant does not include a third resource, TDRA is set to zero and FDRA is set with $L\_{subch}$ the same as the corresponding value provided in DCI.
	+ For the SCI transmitted in the third granted resource (for DG) or in the third resource in a period (for CG), the values of TDRA is set to zero and FDRA is set with $L\_{subch}$ the same as the corresponding value provided in DCI.

 **(For other answers, please explain)**

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| **Company** | **View** |
| NTT DOCOMO | Agree[DCM2] support the updated proposal. |
| Intel | AgreeWe expect a UE is instructed to copy FDRA and TDRA fields from DCI 3\_0. |
| OPPO | Agree  |
| vivo | Agree.[vivo-2020/08/20]Generally fine with the spirit of the proposal, but we think the wording can be refined because ‘point to the third resource’ seems to imply that SCI has no information for the 2nd resources itself, which is not true.Regardless of whether there are other resources after a granted resource carrying a SCI, the FRIV in the SCI should at least indicate the bandwidth information (i.e.,$ \_{}$) of the granted resource, in the other words $\_{}$ derived from FRIV in the SCI is applicable for the granted resource itself. so we think it is more accurate to say: the values of TDRA and FDRA ~~point to~~ indicate the second and third granted resource (for DG) or the second and third resource in a period (for CG). If the grant does not include a third resource, TDRA is set to zero and FDRA is set with $L\_{subch}$ the same as the corresponding value provided in DCI. |
| LG Electronics | **We are supportive of FL’s proposal**. Note that for Mode 1 operation, it should be specified that the information of time/frequency resource assignment configured/scheduled by the network (e.g., activation DCI for CG Type 2, RRC signalling for CG Type 1, re-TX DG for CG Type 1 and DG) is inherited by SCI format 1-A.[LG2] We share the same view with Sharp. So, it’s fine with the revised version of Sharp. |
| ZTE, Sanechips | Agree. |
| Apple | Agree |
| Sharp | Agree in principleOn top of the above agreements, we think further clarification is needed to set TDRA/FDRA fields. For the first transmission scheduled by DCI 3\_0 or indicated in CG, it is natural to copy both fields. While for the second transmission(if any), e.g. N\_max=2, since backward signalling is not supported, the SCI only needs to indicate the second transmission itself(i.e. TRIV in TDRA field is set as 0). Thus, it is incorrect to simply copy the fields of TDRA/FDRA from DCI 3\_0. Briefly, the SCI associated with the first transmission indicates 1st and 2nd SL resource and the SCI associated with the second transmission indicates only the 2nd SL resource. Accordingly to the above discussions, we propose the following clarification:A UE that transmits a PSCCH with SCI format 1-A corresponding to the $i$-th ($1\leq i\leq N$)resource indicated by the SL grant using sidelink resource allocation mode 1 [6, TS 38.214] sets - the values of the frequency resource assignment field and the time resource assignment field to indicate $i$-th , ($i$ +1)-th,…, N-th resource as described in [6, TS 38.214].FL reply (19/8/20):I have clarified this in the proposal. I think your wording works for DG but not for so easily for CG, where we need to restrict reservations to be signaled within a period only. We can discuss the details when drafting the TP.[Sharp\_2]We share similar view with NOK that FDRA set to 0 is incorrect. To avoid the issue that our wording does not work well for CG(similar view for NOK’s proposed wording), the following changes based on FL’s proposal is as follows,* + For the SCI transmitted in the first granted resource (for DG) or in the first resource in a period (for CG), the values of TDRA and FDRA are the ones provided in DCI.
	+ For the SCI transmitted in the second granted resource (for DG) or in the second resource in a period (for CG), the values of TDRA and FDRA point to the third granted resource (for DG) or the third resource in a period (for CG). If the grant does not include a third resource, TDRA is set to zero and FDRA is set with $L\_{subch}$ the same as the corresponding value provided in DCI.
	+ For the SCI transmitted in the third granted resource (for DG) or in the third resource in a period (for CG), the values of TDRA is set to zero and FDRA is set with $L\_{subch}$ the same as the corresponding value provided in DCI.

FL reply 20/8/2020:Thanks for the clarification. I have incorporated it. |
| Qualcomm | We agree with the proposal and think the that issue brought up by Sharp is also a valid one[QC2] We agree with the principle, but a change for FDRA is needed as mentioned by Sharp and Nokia. |
| CMCC | Agree FL’s proposal with Sharp’s clarification. |
| CATT | Agree.[CATT2] 20/8/2020Regarding the updated proposal, we agree with it on the time & frequency domain resource indication. But the issue mentioned by Huawei,HiSi should be clarified.* How many resources can be configured in each CG period? The maximum number is 3 (N\_max), or more than 3 as the maximum HARQ re-tx number (*sl-CG-MaxTransNum*)?
* If more than 3 resources are configured in each CG period, how to indicate the rest resources except the first 3 (if N\_max is 3), by CG or by DCI?

FL reply 20/8/2020:My understanding is that it is not possible to signal more than 3 resources.See also my reply to Huawei, HiSilicon [CATT3] 21/8/2020Thanks for the answer on the two questions for clarification.As you mentioned, no more than 3 resources can be configured within one CG period. But reading the views from Huawei, HiSilicon, they still think that more than 3 resources (less than 32) can be configured. I think companies have different views on the “Maximum number” of Tx resources provided by configured grant.* N\_max: 1/2/3
* *sl-MaxiTransNum-r16*: 1~32

For a configured grant, a maximum number is configured first with selection from 1~32, e.g. 10, which means a TB can be transmitted and re-transmitted no more than 10 based on HARQ-ACK. When N\_max=3, it means SCI can indicate at most 3 time & frequency resources.* For CG Type-1, the first 3 transmissions are indicated by RRC signalling, and the rest 7 (if needed) will be dynamically scheduled by using DG specific rsources.
* For CG Type-2, the first 3 transmissions are indicated by DCI which also copied by SCI. the rest 7 (if needed) will be dynamically scheduled by using DG specific rsources.

With the above analysis and previous agreements, we can have the following clarifications:* **No more than 3 resources are configured in one CG period.**
* **Re-transmissions scheduled by DG can only use DG specific resources, but not using/indicating any CG resources.**

FL reply 24/8/2020:I think that is the current understanding. |
| Huawei, HiSilicon | Agree in principle, but only according to the agreements above, the resource configuration are not complete. For configured grant, the time-frequency allocation uses the same format as in DCI, thus the higher layer parameters *SL-ConfiguredGrantConfig* for configured grant type 1 can only provide three resources at the most. However, due to the configuration of the maximum number of times for configured grant, one TB can be transmitted up to 32 time using the resources provided by the CG. Therefore, the current CG resource configuration and existing higher-layer parameters cannot support such scheduling. Furthermore, RAN2 has agreed that it is not allowed to use CG resource in next period for a TB retransmission. So in order to support max 32 times transmission and provide enough flexibility on CG retransmission resources configuration, we can further discuss the following question in addition to the proposal:***Whether to support resource repetition within a period? If yes, how to configure the repetition, i.e. whether new RRC parameters are needed.***For the issue, we think the repetition of the existing three CG resources regarded as a group could be applied. A new higher layer parameter which indicates the interval between the groups of resources configured by the existing higher layer parameters should be added in *SL-ConfiguredGrantConfig* information element in TS 38.331.FL reply (19/8/20):My understanding of the contributions is that this change is not widely supported. Besides this, introducing RRC parameters should be avoided at this point.[HWHiSi\_2] (20/08/20)Thanks for reply. The essential issue is the current spec is incompelete. We have agreed to support up to 32 (re-)transmission for a TB, but we are not clear how to support it for the configured grant. Note RAN2 has made an agreement that a TB for a HARQ Process ID cannot be transmitted cross periods, it means the transmissions have to be finished within a period.That is why we think it is naturally and beneficial to support the resource repetition within a period, which is already supported in NR Uu. It can swtich CG transmission to DG indeed, but it will cost lots of signalling since only up to 3 resources can be indicated by DCI format 3\_0.For the RRC impact, we adimit new parameters may be introduced depends on discussion output, but we cannot preclude to define the new things to make spec complete and functional in case that we do not want to bring new RRC parameters. On the other hand, ASN.1 will be frozen until September plenary, it seems ok to introduce a new RRC parameter.FL reply 20/8/2020:I don’t recall making an agreement that up to 32 (re-)transmissions of a TB are supported for Mode 1. I only recall the following agreement for Mode 2:Agreements:* At least for mode 2, (Pre-)configuration can limit the maximum number of HARQ (re-)transmissions of a TB
	+ Up to 32
	+ FFS the set of values
	+ FFS signaling details (UE-specific, resource pool specific, QoS specific, etc.)
	+ If no (pre)configuration, the maximum number is not specified
	+ Note: this (pre-)configuration information is NOT intended for the Rx UE

I think that the agreement is clearly restricted to Mode 2. Let me know if I missed some other agreement. Besides this, the gNB can use DG to schedule additional retransmission. I understand that your proposal would give more flexibility, but it is not an essential correction.[HWHiSi\_3] (21/08/20)We had an agreement to configure the maximum number of the transmission for a TB using the resource provided by configured grant is configured per priority and per CG and in TS38.331, the number is as large as 32.So if the resources configured by CG are more than 3, how does the spec support that? Note, it is clear to say the resources provided by CG.FL reply 24/8/2020:32 is a signalling choice by RAN2. It does not reflect any RAN1 agreement.  |
| Samsung | Agree FL’s proposal. Sharp’s clarification also make sense.[Samsung2] Agree in principle. But setting FDRA to 0 is inaccurate, as clarified by Sharp and Nokia. |
| Ericsson | We are fine with the proposal and Sharp’s clarification |
| Nokia, NSB | Agree with FL’s proposal + Sharp’s point.[NOK2] “FDRA … set to zero” is not correct, since FDRA encodes not just starting sub-channel index for the (here non-existing) future resources but also L\_subCH, the number of allocated sub-channels. FDRA can be zero only if L\_subCH=1. This could be fixed and text simplified by writing e.g. “TDRA and FDRA point to the remaining future granted resources …, if any”. FL reply 20/8/2020:You are right on “FDRA … set to zero is not correct”. I will fix it. Note that “TDRA and FDRA point to the remaining future granted resources …, if any” is not good either. Although it works for DG, it does not exclude signalling across period for CG. That is the reason for my detailed proposal  |
| Futurewei | We support the proposal. Sharp’s clarification is also valid |
| Spreadtrum | We agree with FL’s proposal and Sharp’s clarification |

### Other TPs with editorial/minor corrections

Contributions with TPs (editorial, minor corrections) related to this topic:

* R1-2005797
* R1-2006434 (Proposal 1)
* R1-2006558 (Proposal 5)

The understanding of the FL is that all related corrections are addressed in the ongoing discussion.

## 1.2 DCI aspects

### Issue 1.2-1 Alignment of DCI format 3\_0 with other DCI formats

**In the past, RAN1 made the following agreement and WA**

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| Agreements:* Existing DCI size budget is maintained when the UE is configured with SL
* (working assumption): The size of the new DCI format and the size of one of the existing NR DCI formats are aligned.
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**FL summary (19/8/2020):**

* Views are again split on this issue:
	+ Some companies argue that DCI format size may not be necessary in all cases.
	+ Zero padding DCI format 3\_0 / 3\_1 to meet the size of some other configured DCI format is agreeable to most companies. There is no consensus on which format to use for this purpose.
	+ There are a few objections on zero padding a non-SL DCI format to meet the size of DCI format 3\_0 / 3\_1
* Given the quite different views, I have created the following proposal.

**Proposal:**

* If the DCI size budget is not exceeded, no alignment of DCI format 3\_0 / 3\_1 with other NR DCI formats is performed.
* If the DCI size budget is exceeded, DCI format 3\_0 / 3\_1 is zero-padded until the size is equal to that of the next DCI format (in size).
* The UE does not expect that the following two conditions happen simultaneously:
	+ The DCI size budget is exhausted
	+ DCI format 3\_0 / 3\_1 is larger than all other configured DCI formats.

**The following was agreed during the GTW session on 19/8/2020**

Agreements:

* If the DCI size budget is not exceeded, no alignment of DCI format 3\_0 / 3\_1 with other NR DCI formats is performed.
* If the DCI size budget is exceeded, DCI format 3\_0 / 3\_1 is zero-padded until the size is equal to that of the next large Uu DCI format (in size).
* The UE does not expect that the following two conditions happen simultaneously:
	+ The DCI size budget is exhausted
	+ DCI format 3\_0 / 3\_1 is larger than all other configured DCI formats.
* Note: the DCI size budget is performed for Uu DCI formats first, before the considerations for DCI format 3\_0/3\_1 as listed in the above bullets

It seems to be necessary to clarify to which cell the size budget refers too. Based on the e-mail discussion, my proposal is to take the cell on which the DCI is received. To illustrate the point, consider the following cases:

* Case 1: PCell with Uu and SL (cell#1). No more cells. DCI can be received in cell#1.
	+ Self-scheduling (i.e., DCI received in cell#1). In this case, the DCI size budget should refer to that of cell#1.
* SCell with Uu and SL (cell#2). In addition, there is PCell (cell#1). DCI can be received in cell#1 or cell#2.
	+ Case 2.1: Self-scheduling (i.e., DCI received in cell #2). In this case, the DCI size budget should refer to that of cell#2.
	+ Case 2.2: Cross-carrier scheduling (i.e., DCI received in cell #1). In this case, the DCI size budget should refer to that of cell#2.
* Dedicated SL cell (cell#3). In addition, there is PCell (cell#1) and, possibly, SCell (cell#2). DCI can be received in cell#1 or cell#2 (if configured).
	+ Case 3.1: DCI received in PCell (cell#1). In this case, the DCI size budget should refer to that of cell#1.
	+ Case 3.2: DCI received in SCell (cell#2). In this case, the DCI size budget should refer to that of cell#2.

**Proposal:**

* In he preceding agreement, the DCI size budget refers to the budget of the cell on which the DCI is received.

Please share your views on the proposal

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| **Company** | **View** |
| NTT DOCOMO | We have same view with the above ‘Case’s. But this proposal seems against case 2.2, is it incorrect? If this proposal is aligned with the above view for case 2.2, we are fine it. |
| LG Electronics | We disagee FL’s proposal. In other words, our preference is to reuse the existing NR Uu principle as musch as possible. For example, in case when SL is scheduled in one of cells configured for NR Uu operation, the reference of DCI size budget is the budget of the cell in which the SL scheduled by DCI is performed. If SL is scheduled in ITS dedicated carrier, there is no reference of DCI size budget. For this case, it is not necessary to define the budget of one of cells (configured for NR Uu operation) as the reference of DCI budget size considering that this situation can be assumed as one additional scheduled cell/carrier is increased. In summary, our suggestion is below:* *In the preceding agreement, the DCI size budget refers to the budget of the cell in which the SL scheduled by DCI is performed.*
* *When the SL scheduled by DCI is peformed in ITS dedicated carrier, there is no reference of DCI size budget.*
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### Issue 1.2-2 Cells on which the UE monitors DCI formats 3\_0 and 3\_1

**One contribution proposes to clarify that the UE monitors DCI formats 3\_0/3\_1 (if configured) only in PCell** (**R1- 2006769). Another contribution discusses PUCCH cell as well (R1-2006694).**

**FL summary (19/8/2020):**

* The majority of companies (but not all), do not think that it is necessary to restrict the monitoring of DCI formats 3\_0 and 3\_1 to PCell.
* For the second bullet, several companies have argued that SL should follow the NR Uu design allowing PCell and PSCell.

**FL summary (20/8/2020):**

* **There was one comment stating that RAN2 does not support the scenario where PUCCH carrying SL HARQ-ACK reports is transmitted on PSCell.**

**Proposal:**

* **DCI formats 3-0 and 3-1 are monitored on PCell and SCell.**
* **PUCCH carrying SL HARQ-ACK reports is transmitted on PCell.**

During the GTW session on 21/8/2020, the following was agreed:

Agreements:

* DCI formats 3-0 and 3-1 are monitored on PCell or a SCell.
	+ Discuss further offline whether it’s a same-carrier scheduling case only or not
		- No RRC impact is expected
* PUCCH carrying SL HARQ-ACK reports is transmitted on PCell
	+ Discuss further offline the applicability or not to PUCCH Scell in case of two PUCCH groups in CA

My understanding is that cross-carrier scheduling is at least necessary for the SL dedicated carrier.

**FL summary (24/8/2020):**

* From the replies, it seems that:
	+ Supporting cross-carrier scheduling is necessary. Moreover, the support has no additional RRC imact.
	+ PUCCH carrying SL-HARQ reports on PUCCH Scell should be supported but cross-group PUCCH should be avoided.
* Based on the views expressed by the differenc companies, I have prepared the following proposal:

**Proposal:**

* Cross-carrier scheduling is supported
	+ From RAN1 perspective, no additional RRC signaling is necessary.
* PUCCH carrying SL HARQ-ACK reports on PUCCH SCell is supported.
	+ The carrier on which DCI is received determines the PUCCH group to be used.

Please share your views for the points above using the new table (the old table can be found in the appendix, for reference).

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| **Company** | **View** |
| NTT DOCOMO | * Regarding same-carrier scheduling only or not,

We have same understanding with FL, at least for dedicated carrier case, cross-carrier scheduling is essential for mode 1. For shared carrier case, we think SL can follow Uu cross-carrier scheduling capability.Regarding RRC impact, no impact is assumed since Rel-16 supports only one SL carrier. For example, PDCCH for SL is configured cell#1 and SL is configured cell#2. If cell#1 = cell#2, it is same carrier scheduling. If cell#1 is not cell#2, it is cross carrier. That’s all. No additional parameter is necessary.* Regarding applicability or not to PUCCH SCell,

First of all, note that in NR-CA like band A + band B in FR1, PUCCH SCell can be configured. Band A with PCell is one PUCCH group, band B with PUCCH SCell is another PUCCH group, for example. In this case, One PUCCH is transmitted on band A and another PUCCH is transmitted on band B. HARQ feedback is performed independently between two PUCCH groups.If SL can be used in this scenario, and when SL carrier is in band B, the SL HARQ feedback to gNB should be done at PUCCH SCell in band B, rather than PCell. Cross PUCCH-group feedback is not reasonable. This is intention of my question at GTW.[DCM2]For first bullet, we are fine, but based on QC’s comment on GTW, always support of cross-carrier would not be agreeable...?For second bullet, sub-bullet is fine for shared carrier, but maybe not fine for dedicated carrier as HW commented below. SL dedicated carrier does not belong to any Uu PUCCH group. In this case, any carrier would be fine for SL. So our suggestion is the following update.* PUCCH carrying SL HARQ-ACK reports on PUCCH SCell is supported.
	+ For shared carrier, ~~T~~the carrier on which DCI is received determines the PUCCH group to be used.
 |
| vivo | **1. Regarding same-carrier scheduling only or not**Regardless SL frequency is sharing the same carrier with Uu or not, SL and Uu cell are configured separately and should be considered as two objects. So I think it is feasible to always ***treat mode-1 scheduling as cross-carrier scheduling.***Regarding the RRC impact, we share the same view as DOCOCMO that ***no additional RRC configuration is needed.*** **2.Regarding applicability or not to PUCCH Scell**We think reporting SL HARQ-ACK on a ***PUCCH Scell should be considered.***According to 38.213 7.1.2, there can be two PUCCH cells in CA case. For cells whose associated feedback is transmitted on the same PUCCH cell, they are considered as a PUCCH cell group. There can be two PUCCH cell groups is PUCCH Scell is configured.===================38.213 7.1.2=====================*If the UE is configured with a PUCCH-SCell, the UE shall apply the procedures described in this subclause for both primary PUCCH group and secondary PUCCH group.**- When the procedures are applied for the primary PUCCH group, the term 'serving cell' in this subclause refers to serving cell belonging to the primary PUCCH group.**- When the procedures are applied for the secondary PUCCH group, the term 'serving cell' in this subclause refers to serving cell belonging to the secondary PUCCH group. The term 'primary cell' in this subclause refers to the PUCCH-SCell of the secondary PUCCH group.*===================end==================According to the red text above, it can be derived that a DL grant on a cell and its corresponding HARQ-ACK feedback should belong to the same PUCCH group. In other words, cross-PUCCH group feedback is not allowed.The associated PUCCH cell (PUCCH Pcell or PUCCH Scell) for a cell is configured by IE PUCCH-cell. If cell#1 schedules SL and if the PUCCH cell of cell#1 is configured as PUCCH Scell, then the SL HARQ-ACK shall be transmitted on the PUCCH Scell. If feedback on PUCCH Scell is not allowed in this case, then we may need to support cross-PUCCH group feedback which seems violates the R15/16 Uu principle. The example is illustrated in the below figure.A straightforward way to specify the SL HARQ-ACK reporting is to use the PUCCH cell associated with the cell scheduling SL for SL HARQ-ACK reporting. ***To be specific, if the cell configured with SL DCI belongs to the primary PUCCH group, then PUCCH Pcell is used for SL HARQ reporting, otherwise, PUCCH Scell is used.*** There is no need to introduce new RRC parameter. |
| Huawei, HiSilicon | In our understanding, cross-carriers should be also supported, which includes 3 typical cases: Case 1: same-carrier scheduling on shared bandCase 2: cross-carrier scheduling, one shared carrier schedules the dedicated SL carrierCase 3: cross-carrier scheduling, one shared carrier schedules a shared carrierThis is because the SL transmission could occur either in the dedicated carrier or a shared the carrier, so case 1 and case 3 are supported. If the CA in NR Uu is enabled, case 2 could be supported as well. For supporting the cross-carrier scheduling, a carrier indicator can be captured in the DCI format 3-0/3-1 which is 3bits at most same as DCI format 0\_1.When two PUCCH groups are supported by a UE, which cell is used to transmit HARQ information depends on gNB configuration in NR Uu. Thus, SL HARQ transmission could reuse the same way. ***For the cross group feedback pointed out by DCM and Vivo, we agree this should be avoided, but acutally we do not know the dedicated carrier for SL should belong to which PUCCH group, companies can clarify it?*** For the wording of “PCell or SCell”, we have a question for that, does it imply gNB should configure which cell is used to monitor DCI format 3-0/3-1 in advance? If so, it seems to introduce a new RRC parameter. [DCM2] Thank you for question, we think you are right, dedicated SL carrier does not belong to any PUCCH group for Uu. So the restriction of the sub-bullet in FL’s proposal is needed only for shared carrier case. Regarding RRC configuration, sl-PDCCH-Config is included in BWP-DownlinkDedicated, which is configured per ServingCellConfig. It means, already in current 38.331, SL PDCCH is configured with one serving cell. Therefore, no additional RRC parameter is OK. |
| LG Electronics | Firstly, we think that by reusing the existing serch space configuration, it is possible to indicate which cell is used for monitoring DCI format 3-0/3-1.Secondly, as explaned by other companies, we also think that the cross-carrier scheduling needs to be supported for Mode 1.Thirdly, in case when two PUCCH groups are configured for Uu, it seems straightforward to transmit “PUCCH carrying SL HARQ-ACK report” to PUCCH cell of CG to which the cell with DCI formt 3\_0/3\_1 monitoring belongs. |
| Apple | For DCI format 3\_0/3\_1 monitoring on PCell or a SCell, we think it can cover cross-carrier scheduling. Cross-carrier scheduling is important for dedicated SL carrier, and we need to support cross-carrier scheduling in Mode 1. For PUCCH carrying SL HARQ-ACK report, we support the applicability of reporting on PUCCH SCell in case of two PUCCH groups. Basically, the SL HARQ-ACK report can be on the PUCCH associated with the cell for monitoring DCI format 3\_0/3\_1.  |
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### Other TPs with editorial/minor corrections

The FL has not identified any TP on DCI aspects in the contributions.

## Other comments

NOTE: I will prepare TPs or list of TPs for editorial aspects. I will share it in a later iteration.

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# Appendix: Previous discussions

### Issue 1.2-1

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| **Company** | **View** |
| NTT DOCOMO | Basically DCI format 0\_1.But the following two cases should be discussed:- when DCI format 0\_1 is not configured- when there is no DCI format configured with larger payload size than 3\_0 |
| Intel | First, we think there could be cases when the DCI budget is respected without alignment.When alignment is necessary, we prefer the closest larger DCI format from 0\_x, 1\_x by zero-padding 3\_0 to the closest format.If 3\_0 turns out the largest format itself* + - * Option 1: UE does not expect such configuration
			* Option 2: Align 0\_1 by zero-padding to 3\_0
 |
| vivo | The reference DCI should be a non-fallback DCI(DCI format x-1/ x-2). And we prefer to avoid zero-padding to x-2 which are introduced in R16.Case1. SL DCI has a smaller size than some non-fallback DCI (e.g., x-1/x-2). To avoid too many inserted bits, the size of SL DCI should be aligned to a non-fallback DCI format with the smallest value among the NR Uu non-fallback DCI format that has a larger size than SL DCI before the padding. Case2. If sizes of DCI format 0-1/1-1 are smaller than SL DCI, a DCI format with the larger size among the non-fallback DCI 0-1/1-1 is padded to align with SL DCI. Case3. If no non-fallback DCI x-1 is configured on the serving cell configured with SL DCI, it is considered as an error case. So, the proposal is:* ***If UE is configured to monitor DCI format 3\_0 on a serving cell and there is at least one non-fallback DCI with size larger than DCI format 3\_0, the size of DCI format 3\_0 is zero-padded to the same size as a DCI format with the smallest value among the NR Uu non-fallback DCI formats that has a larger size than DCI formats 3\_0 prior to the padding on the serving cell.***
* ***If UE is configured to monitor DCI format 3\_0 on a serving cell and the size of DCI format 3\_0 is larger than NR Uu non-fallback DCI format 1\_1/0\_1 on the serving cell, the Uu non-fallback DCI with the larger size between DCI format 1\_1/0\_1 is padded to align with DCI format 3\_0.***
* ***At least one non-fallback DCI format 1\_1/0\_1 is configured for the serving cell configured with DCI format 3\_0 or 3\_1***

Apart from the reference DCI format for size alignment, we also need to determine the cell of the reference DCI. If the serving cell (e.g. cell#1) configured with SL DCI can schedule another Scell (e.g. cell#2), there would be two DCI format groups on the Pcell, i.e., one group for DCI for cell#1 self-scheduling and the other for DCI for cross-carrier scheduling cell#2. In this case, it is unclear which DCI group provides the reference DCI format that should be considered for SL DCI size alignment. Since the configuration between the two cells can be quite different, the difference in size between the non-fallback DCI for self-scheduling or the non-fallback DCI for cross-carrier scheduling can be substantial. To keep it simple, we prefer to align SL DCI to non-fallback DCI for Uu self-scheduling.* ***If UE is configured to monitor DCI format 3\_0 on a serving cell, DCI format 3\_0 size should be aligned to a non-fallback DCI scheduling the same serving cell***
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| LG Electronics | First of all, we don’t think that it is necessary to limit “Uu DCI format of USS” used for size alignment of DCI format 3\_0. Details of our proposal are as follows:* **If the DCI format size budget is not fully used, no size alignment for DCI format 3\_0 is done. On the other hand, if the DCI format size budget is fully used, DCI format 3\_0 size is aligned to one of “Uu DCI formats of USS” such that the number of padded zeros is minimized.**
 |
| ZTE, Sanechips | Our preference is NOT to confirm the WA. The impact of DCI 3\_x to overall DCI size budget can be left as gNB implementation, similar to the case of DCI Format 2\_x (eg. DCI Format 2\_0). This preference is based on following considerations.* The DCI sizes of fall-back DCIs (i.e., DCI 0\_0 and DCI 1\_0) should not be changed due to adding of SL operations.
* The UE may have no configurations relating to detection of DCI 0\_1 and DCI 1\_1, e.g., the UE is not configured to use DCI 0\_1 and 1\_1.
* In case DCI 3\_x size is larger than the size of target alignment DCI, shortening DCI 3\_x by removing most significant bits in frequency assignment field may not work due to inclusion of multiple Tx occasions in one DCI.
 |
| Apple | If NR DCI format 3\_0 is not the largest DCI format to be monitored, then it is zero padded to the smallest NR Uu DCI format which is larger than DCI format 3\_0. If NR DCI format 3\_0 is the largest DCI format to be monitored in a search space, then the largest NR Uu DCI format is zero padded to DCI format 3\_0. |
| Sharp | It should be first clarified whether the size alignment is done Case 1: as part of the “DCI size alignment” procedure (section 7.3.1.0 in 38.212) or Case 2: after the DCI size alignment procedure. Case 1 complicates the existing DCI size alignment procedure a lot and is undesirable in our eyes. If Case 2 is adopted, it would be most efficient and future-proof to pad 3\_0 to whatever is the closest larger NR Uu DCI size for the cell, and we don’t see any technical reason why the target format should be restricted to 0\_x or 1\_x (as proposed by some other companies). If 3\_0 is the largest among all DCI sizes, it OK to either specify it as an error configuration, or zero-pad the largest NR Uu DCI size to align with 3\_0. |
| Qualcomm | DCI 3-0 and the next largest of DCI 0-1 and DCI 1-1 are size aligned.If none of the above Uu DCI formats is configured or are all smaller than DCI 3-0 and the DCI size budget would be exceeded otherwise, DCI 3-0 and DCI 0-0 or 1-0 are size aligned. |
| CMCC | DCI format 0\_1. If UE is not configured to monitor DCI format 0\_1, the DCI format with minimum size different between DCI format 3\_0 and the selected DCI format is used for size alignment by zero padding the format with smaller size. |
| CATT | DCI format 0\_1 as baseline for the size alignment. |
| Huawei, HiSilicon | According to the agreements in RAN1#99, on a given scheduling cell and a given PDCCH monitoring occasion, either PDCCH carrying a DL grant or PDCCH carrying a SL DG is configured. Thus gNB will avoid scheduling a Uu DCI and SL DCI together, and the network configuration can ensure the blind decoding not to exceed the maximum number of monitored PDCCH candidates. So it is no need to align DCI 3\_0 with another Uu format size. |
| Samsung | At first, if size budget is not exceeded, no DCI alignment is necessary. Otherwise DCI format 3\_0 is aligned with one existing DCI format.Then we consider DCI format 0\_1 as reference DCI format size. If UE is not configured configured with DCI format 0\_1:* If DCI format 3\_0 is not the largest DCI format size, DCI format 3\_0 is padded to align with existing DCI format with closest larger size.
* Otherwise if DCI format 3\_0 is the largest DCI format size, one existing DCI format with largest size is padded to align with DCI format 3\_0.
 |
| Ericsson | DCI format 0\_1 |
| Futurewei | DCI format 0\_1 |
| Spreadtrum | When DCI alignment is necessary, align DCI 3-0 with one existed non-fallback DCI format. |

### Issue 1.2-2

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| **Company** | **View** |
| NTT DOCOMO | For 1st bullet, we are not sure the restriction is needed.- For example, if SL is operated on a shared carrier and the carrier is SCell, then it seems that SL scheduling from the same cell is more feasible.For both bullets, we would like to clarify whether NR-CA with PUCCH SCell or NR-DC is considered for this discussion or not.- If not considered, discussion on the 1st bullet is only above our comment and the 2nd bullet is unnecessary since PUCCH can be transmitted on PCell only.- If considered, restriction on cross-FR/band/PUCCH-group scheduling shall be discussed since it would not be OK from UE implementation perspective. Otherwise, any scheduling combination among PDCCH/SL-resource/PUCCH is allowed, e.g. PDCCH is band X in FR1, SL is band Y in FR1, and PUCCH cell is FR2. Note that, PUCCH SCell or PSCell is the other candidate for PUCCH cell, in this case. So the 2nd bullet needs to be discussed.- We believe that ‘NR-CA with PUCCH SCell or NR-DC’ should be considered in RAN1. Current RAN4 spec does not support, but would support in future. In the timing, time for RAN1 discussion is not guaranteed.[DCM2] We would appreciate it if anyone could kindly provide clear answer for the following aspect; otherwise, we think proposal leads to potential issue.- whether NR-CA with PUCCH SCell or NR-DC is considered for this discussion or not. |
| Intel | Neutral. If there is no much specification effort to support non-PCell scheduling and PUCCH, we are open. |
| OPPO | No necessary for this proposal. For the first bullet, similar view as DOCOMOFor the second bullet, PUCCH in NR Uu can be transmitted in PCell or PScell. Follow existing PUCCH mechanism is enough.  |
| vivo | * Regarding 1st bullet.

We think the first bullet is not necessary. We don’t see the necessity of introducing such restrictions. From the perspective of scheduling, there are no big differences between Scell scheduling and Pcell scheduling, thus enabling a SL DCI transmission on a scell does not introduce additional complexity compared with Pcell scheduling SL case. Additionally, allowing Scell scheduling SL has some benefits. For example, when the Pcell is in a heavy load and the PDCCH capacity of Pcell is limited, gnb can offload the SL scheduling to a Scell with less PDCCH transmissions to reduce the burden of Pcell. * Regarding the second bullet

Generally fine to define the PUCCH cell for SL HARQ-ACK reporting, we prefer to change ‘Pcell’ to ‘PUCCH Pcell’.For PDSCH scheduling, an IE PUCCH-cell is included in PDSCH-ServingCellConfig to indicate whether HARQ-ACK for the PDSCH is transmitted on PUCCH SPcell or PUCCH scell. If IE PUCCH-cell is absent, HARQ-ACK should be transmitted on PUCCH Pcell by default.

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| ***pucch-Cell***The ID of the serving cell (of the same cell group) to use for PUCCH. If the field is absent, the UE sends the HARQ feedback on the PUCCH of the SpCell of this cell group, or on this serving cell if it is a PUCCH SCell. |

Since there is no such PUCCH-cell IE defined for SL scheduling so far, we can follow the behavior similar to the case where PDSCH-ServingCellConfig is configured without PUCCH-cell indication, i.e., PUCCH carrying SL HARQ-ACK reports should be transmitted on PUCCH Pcell. Alternatively, we can introduce a PUCCH-cell IE for SL configuration and follow the existing mechanism.[vivo-2020/08/20]Prefer to change ‘and’ to ‘or’. we think scell scheduling SL is possible especially when the Scell is sharing the same/overlapped carrier with SL. But we don’t want to have Pcell and Scell configured with SL DCI at the same time. In R15 and R16, there is a principle that a cell can only be scheduled by one cell (i.e., itself or another cell), we believe that it is against the design principle of R15/R16 to have SL DCI format configured for more than one Uu cells (although SL carrier is not considered as a ‘normal’ serving cell in the usual sense, we understand that SL scheduling should follow this principle as well. So propose to change the first bullet as:**DCI formats 3-0 and 3-1 are monitored either on PCell or on a SCell**Regarding the second bullet, it is true that R16 does not support SCG scheduling SL and we are fine to remove PScell. But for CA case, there can be two PUCCH cell, i.e., PUCCH Pcell and PUCCH Scell. PUCCH Scell can be considered for HARQ reporting.**PUCCH carrying SL HARQ-ACK reports is transmitted on PUCCH PCell or PUCCH Scell.** |
| LG Electronics | To our understanding, in the current RAN2 specification (i.e., TS 38.331), there is no RRC parameter indicating a cell used for monitoring DCI format 3\_0/3\_1. Also as per RAN2 agreement, the scenario where SL is controlled/configured by Secondary Node is not considered in Rel-16 NR V2X. As a result, **we are supportive of FL’s proposal** that is also aligned with the principle of LTE V2X. Note that even in case when DCI format 3\_0 is only monitored on PCell, the relevant SL TX can be performed in “another Cell (e.g., SCell)” or “one of ITS dedicated frequencies”. So, **we need to introduce “Carrier Indicator Field” in DCI format 3\_0**.[LG2] According the following RAN2 agrement, in Rel-16, we don’t need to consider the sceanario where “Mode 1 operation is controlled by a Cell belonging to SCG in DC” and “PUCCH of SL HARQ-ACK is transmitted in a Cell belonging to SCG in DC”. So, “PSCell” should be removed in FL’s proposal.* RAN2 agreement made in RAN2#106:
* RAN2 does not consider the scenario where SL is controlled/configured by SN in Rel-16 NR-V2X.

FL reply (20/8/20):Thanks for the clarification. See the updated proposal. |
| ZTE, Sanechips | **Support FL’s proposal.** Our main concern comes from timing. PCell and SCell may have different timing, and the earlier RAN1 discussion did not assume different timings to be applicable to DCI detection and PUCCH transmission carrying SL HARQ-ACK. This is to say it is better to limit the DCI detection and PUCCH transmission on the same cell. Further, NR Uu does not support ACK/NACK on PUCCH belonging to SCell. Then the choice is left between PCell and PSCell. We think it is safer to pick PCell where the UE normally obtains SIB information for SL configurations (“safer” means that the other way around may not be soly decided by RAN1).  |
| Apple | For the first bullet, we think it is not necessary to restrict to monitor DCI 3\_0 only on PCell, especially for the case where sidelink shares the carrier of SCell.For the second bullet, SL HARQ-ACK report can be transmitted in PCell or PScell, like PUCCH in NR Uu. |
| Sharp | We support the FL proposal. |
| Qualcomm | Docomo brings up a valid point about self-scheduling in a shared carrier that we did not address in our contribution. In this case, we think the proposal needs to be updated so that when cross-carrier scheduling is enabled for the sidelink carrier, DCI 3-0 and 3-1 are only monitored on PCell, while self-scheduling on an SCell is used when configured.For the second proposal on PUCCH cell, our understanding is that this is the current behavior in specifications, but we’re ok with having an explicit agreement for clarity.FL reply (19/8/20):Your proposal on the first bullet looks a bit convoluted, I would say. If we need scheduling on SCell, let’s support it for all cases.[QC2] Let me clarify my proposal. If PCell is a shared carrier, then it can be scheduled by PDCCH on PCell. Sidelink transmissions on an SCell can be scheduled form the same cell or from PCell. In the cross carrier scheduling case, the normal procedure and UE capability for cross carrier scheduling apply.In the new FL proposal, does the first bullet assume that cross carrier scheduling is supported for sidelink?On the second bullet, including PSCell opens the discussion about whether to support DC, and it is too late for such a discussion. Therefore, we think PSCell should be removed.FL reply (20/8/20):Regarding the first bullet, it seems that your first paragraph answers the question, right? Cross-carrier scheduling would be supported. Is there some specific case you want to avoid?Regarding the second bullet, see my updated proposal. |
| CATT | We are neutral on this issue. |
| Huawei, HiSilicon | The monitoring space for DCI formats 3-0 and 3-1 can follow the LTE principle, where the restriction of PCell on DCI format 5A is not specified. |
| Samsung | For the 1st bullet, we are neutral on introducing Scell scheduling, but some further issues, e.g. how to configure the cell used to monitor DCI format 3\_0 and DL pathloss of which cell is used for SL PC, needs to be carefully discussed to reduce specification impact.For the 2nd bullet, we prefer to reuse existing mechanism that PUCCH can be transmitted in PCell ~~or PScell~~.[Samsung2] For the 1st bullet, we have a question for clarification: Whether UE expect DCI format 3-0/3-1 is monitored in both PCell and SCell, or UE expect DCI format 3-0/3-1 is monitored in one of PCell and SCell? It has different impact in DCI alignment issue. For example, if UE monitors DCI format 3-0/3-1 in two scheduled cells, in our understanding the size budget in two scheduled cells should be calculated separately and DCI size alignment procedure is performed separately, as NR-CA in Uu. Consequently, DCI format 3-0/3-1 in PCell and in SCell may have different format size after alignment. Otherwise if UE only expect DCI format 3-0/3-1 from one scheduled cell, only in the scheduled cell DCI alignment is needed. This issue is also raised by vivo in email discussion.For the 2nd bullet, we also suggest to remove PScell. In TS 37.340, Clause 13.2, the following is captured: “In MR-DC, only the MN is allowed to control/configure UE(s) performing NR Sidelink Communication and/or V2X Sidelink Communication”. |
| Ericsson | We don’t see the need for the first bullet |
| Nokia, NSB | We are not convinced of the need for the restriction on the cell where DCI is received. |
| Futurewei | First bullet: unclear what benefit there would be in putting such a restrictionSecond bullet: while we do not have any strong view, we do not see why the behaviour would be different than for the Uu link where either Pcell or PScell can be used |
| Spreadtrum | We don’t see the benefit for the restriction in the first bullet. |