**3GPP TSG RAN WG1 #100bis-e R1-20xxxxx**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on Email discussion [100b-e-NR-UEFeatures-Others-01]

Agenda Item: 7.2.11.13

**Document for:** **Discussion and Decision**

# **Introduction**

This contribution summarizes the following email discussion in AI 7.2.11.13 regarding NR UE features for others.

[100b-e-NR-UEFeatures-Others-01] Email discussion/approval on updates for Rel-15 capabilities (20th-24th April) – Hiroki (DCM)

* Confirm the updated FG8-1
* Discuss whether the FGs [5-11c]/[5-12c]/[5-13g]/[5-13h] for up to 3 unicast PDSCHs (PUSCHs) per slot per CC for different TBs are introduced or removed. If there is no consensus to add a new feature group at the end of this email discussion, the new feature group is not introduced in Rel-16.
* Discuss whether the FG [5-35] for simultaneously enabling CBG and multiple PDSCHs per slot is introduced or removed. If there is no consensus to add a new feature group at the end of this email discussion, the new feature group is not introduced in Rel-16.

# **Update for 8-1: Dynamic power sharing for LTE-NR DC**

In [1], the updated FG8-1 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 8. UL TPC | 8-1 | Dynamic power sharing for LTE-NR DC | When total transmission power exceeds Pcmax, UE scales NR transmission power.  | EN-DC | No | N/A |  | Per UE | N/A | N/A |  |  | Mandatory with capability signalling set to 1 |

Following feedback is provided in a contribution for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [6] | Ericsson | 8-1 is in Release 15 mandatory with capability signalling. The proposal is to require Release 16 UEs to set the capability signalling to 1(supported). Ericsson is supportive of this proposal.1. Release 16 UEs are required to set the capability bit for FG 8-1 Dynamic power sharing for LTE-NR DC(8-1) to 1, i.e. supported.
 |

## 2.1 Discussion 1

**The proposal is to confirm the update on FG8-1 (i.e., Rel-16 UEs are required to set the capability bit for FG8-1 to 1).**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | We support our own proposal |
| Nokia | Support |
| Intel | Support. Set to 1 from Rel-16. |
|  |  |

**FL proposal:**

* Updated FG8-1 is kept (i.e., Rel-16 UEs are required to set the capability bit for FG8-1 to 1).

# **New FGs [5-11c]/[5-12c]/[5-13g]/[5-13h] and [5-35]**

In [1], [5-11c]/[5-12c]/[5-13g]/[5-13h] and [5-35] are captured with bracket as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
|  | [5-11c] | Up to 3 unicast PDSCHs per slot per CC for different TBs for UE processing time Capability 1 | Up to 3 unicast PDSCHs per slot per CC only in TDM is supported for Capability 11) PDSCH(s) for Msg. 4 is included |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS. | Optional with capability signalling |
|  | [5-12c] | Up to 3 unicast PUSCHs per slot per CC for different TBs for UE processing time Capability 1 | Up to 3 unicast PUSCHs per slot per CC only in TDM is supported for Capability 1 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS. | Optional with capability signalling |
|  | [5-13g] | Up to 3 unicast PDSCHs per slot per CC for different TBs for UE processing time Capability 2 | Up to 3 unicast PDSCHs per slot per CC only in TDM is supported for Capability 2UE can report values ‘X’ and supports the following operation, only when all carriers are self-scheduled and all Capability #2 carriers in a band are of the same numerology* When configured with less than or equal to X DL CCs, the UE may expect to be scheduled with up to 3 PDSCHs per slot with Capability #2 on all of the configured serving cells for which processingType2Enabled is configured and set to enabled

2) No scheduling limitation3) N1 based on Table 5.3-2 of TS 38.214 for given SCS from {15, 30, 60} kHz | 5-5a or 5-5b | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCSMore than one set of per SCS per band reports can be signalled for a given band combination | Optional with capability signalling |
|  | [5-13h] | Up to 3 unicast PUSCHs per slot per CC for different TBs for UE processing time Capability 2 | Up to 3 unicast PUSCHs per slot per CC only in TDM is supported for Capability 2UE can report values ‘X’ and supports the following operation, only when all carriers are self-scheduled and all Capability #2 carriers in a band are of the same numerology• When configured with less than or equal to X UL CCs, the UE may expect to be scheduled with up to 3 PUSCHs per slot with Capability #2 on all of the configured serving cells for which processingType2Enabled is configured and set to enabled2) N2 based on Table 6.4-2 of TS 38.214 for given SCS from {15, 30, 60} kHz | 5-5c | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCSMore than one set of per SCS per band reports can be signalled for a given band combination | Optional with capability signalling |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | [5-35] | Simultaneously enable CBG and multiple PDSCHs per slot | Simultaneously enable CBG and multiple PDSCHs per slot | 5-11,5-11a, 5-11b, 5-13. 5-13a. 5-13c, 5-22, 5-23, 5-24 | Yes | N/A | gNB is not expected to configure CBG operation and multiple PDSCHs per slot simultaneously. | Per UE | No | Yes | N/A | There is conclusion in Rel-15 that the scenario described in the draft CR (R1-1907505) can happen but can be handled via implementation in which case the UE performance may not be optimal. To ensure the NR data rate performance while maximizing the respective benefits of CBG based operations and multiple PDSCHs per slot, an explicit UE capability of support simultaneous operation is preferable. | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [5] | Samsung | For FGs 5-11c/5-12c/5-13g/5-13h above, there are already capabilities for UE to receive up to 2 or 4 PDSCH/PUSCH, respectively, while the proposed FGs are for UE to receive up to 3 PDSCH/PUSCH. This would bring UE fragmentation with no clear benefits. Also for FG 5-35, this seems a signaling to indicate less capability than Rel-15. It is also not clear to have this signaling.Observation 1. There is no clear benefit to introduce new FGs 5-11c/5-12c/5-13g/5-13h, and 5-35. |
| [6] | Ericsson | Proposals 5-11c/5-12c//5-13g/5-13h all add additional granularity in the number of unicast PUSCH/PDSCH per slot per CC for different TBs that can be configured. Additional discussion is needed before introducing these.Our understanding is that the intention with the introduction of this signalling is to allow a UE that indicates support for both CBG and multiple PDSCH per slot, to indicate no support for being configured with CBG and multiple PDSCHs per at the same time. This means relaxed behaviour compared to Release 15 and is problematic for several reasons. First of all, even though phrased as indicating support, this in practice is a “incapability bit” as stated by RAN2 in their LS in [R1-2001513](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100b_e/Docs/R1-2001513.zip)[2]. Secondly, a Rel-15 network will not receive this signalling from a Rel-16 UE and will assume that the UE supports the combination.1. Do not introduce new capability for simultaneously enabling of CBG and multiple PDSCHs per slot.
 |
| [8] | Huawei, HiSilicon | In the worst case if the number of CBGs is 8, then UE needs to increase its capability 7 times than CBG is disabled if all unsuccessfully decoded CBGs are retransmitted in one slot assuming the maximum number of DL TB per slot is 7. On the other hand, if peak rate performance is sacrificed as concluded in RAN1, significant data rate degrade (more than 10%) can be expected due to e.g. dropping one or more successfully decoded TBs, which further leads to more potential retransmissions consequently and is highly undesirable. Figure 1. One CBG based retransmission exampleIn order to maintain the NR designated peak rate performance, it is desired to solve this problem in Rel-16 and beyond. Several approaches can be considered:* ***Option 1****: Change* $C'$ *to* $C$ *in* $V\_{j,m}$*for DataRate calculation and DataRateCC calculation in subcluase 5.1.3 and 6.1.4 of TS 38.214 as described in R1-1907505.*

However, this requires specification changes and needs to consider impact on Rel-15 implementations.* ***Option 2****: When CBG based retransmission is enabled, only one unicast PDSCH is scheduled per slot.*

However, this restricts the network scheduling and applicable scenarios for CBG based operation especially for traffic heavy/data rate oriented cases.* ***Option 3:*** *UE reports newtork that whether UE supports more than one unicast PDSCH reception per slot on this cell, when CBG based retransmission is configured for a cell.*

This has benefits of no specification impact and actually relying on UE implementation evolution with sufficient flexibility, if the device has the capability to work under the enhanced operation.***Proposal 1****: Agree on FG 5-35 as an optional per-UE reported capability for Rel-16 to indicate whether UE supports more than one unicast PDSCH reception per slot on a carrier when CBG based (re)transmission is configured for that carrier.**~*Firstly, it is not clear if we need additional UE capabilities for the above except for 5-11c, 5-12c, 5-13g, 5-13h as they are already in Rel-15. It seems just some copy-paste from Rel-15 UE feature list thus should be removed from Rel-16 UE feature list for further discussion. Secondly, for 5-11c, 5-12c, 5-13g, 5-13h where *N*=3, the gap between the existing related Rel-15 UE features 5-11/11b, 5-12/12b, 5-13/13c and 5-13d/13f where *N*=2/4 seems small. It is not clear about the motivation from proponents.Lastly, since msgB is introduced from 2-step RACH WI in response to successfully decoding of msgA, which can similar to msg4 when carrying successRAR, further discussion would be needed for relevant UE capabilities in DL. This may be either handled in specific 2-step RACH WI, or as enhanced UE capabilities of DL of FG 5-11 ~ 5-13h.***Proposal 2****: UE capabilities for multiple PDSCHs reception should take msgB into account. Clarify the motivation of up to N PDSCHs/PUSCHs where N=3.* |
| [9] | Qualcomm Incorporated | The proposed changes in 5-11c, 5-12c, 5-13d and 5-13g are to allow for scheduling 3 TBs in both UL and DL. Considering the (4,3) span pattern of FG 3-5b, these additions would allow for matching the number of TBs and the spans in each slot. |

## 3.1 Discussion 2

**Companies are encouraged to provide views on whether the brackets for FG[5-11c]/[5-12c]/[5-13g]/[5-13h] are removed or FG[5-11c]/[5-12c]/[5-13g]/[5-13h] are removed.**

 **Introducing the FG5-11c/5-12c/5-13g/5-13h (removing brackets) supported by:**

 **Objected (i.e., not introducing FG5-11c/5-12c/5-13g/5-13h) by:**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSi | We consider the Rel-15 capability in Rel-16 need to take msgB into account for further discussion. |
| Ericsson | We would like to see other companies view on 5-11c/5-12c//5-13g/5-13h and how many companies are supporting these. There are existing values of existing numbers of 2,4,7 allowed so why is 3 needed in addition?  |
| Nokia/NSB | We do not see the need for the new FGs 5-11c/5-12c//5-13g/5-13h. More technical discussions are needed which go beyond the scope of this exercise. |
| Intel | We are negative to introduce FGs 5-11c/5-12c/5-13g/5-13h. The availability of 3 PDSCHs/PUSCHs per slot to match particular PDCCH span configurations is there already – with 4 and 7 PDSCHs/PUSCHs per slot capabilities. If it were critical in Rel-15, we should have introduced such granularity of ‘3’ from the beginning, which is not the case in our view. Thus, we think further explanations are needed to justify further fragmentation going from 4 to 3 PDSCHs/PUSCHs per slot as yet another set of FGs. |

**FL proposal:**

* FG5-11c/12c/13g/13h are removed (i.e., not introduced in Rel-16).

## 3.2 Discussion 3

**Companies are encouraged to provide views on whether the bracket for FG[5-35] is removed or FG[5-35] is removed.**

 **Introducing the FG5-35 (removing bracket) supported by:**

 **Objected (i.e., not introducing FG5-35) by:**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSi | On FG 5-35.We disagree with the isssue of incapability. The RAN2 LS below is the statement about incapability (copied in the end). For a Rel-15 network does not receive this capability for a Rel-16 UE, the network can schedules both operation without limitation and will not expect the performance is optimal as RAN1 concluded, thus it is the same effect as network may configure an operation that exceeds the Rel-16 UE capability and the UE would not be able to follow. No interpretation issue.On the other hand, there are many simultaneous operations not defined with the capability signalling, however it does not mean that the performance is always as expected, as there are no corresponding test cases or performance requirement. This particular case is raised as it is one of the designated operation for data rate oriented operation for eMBB, and we don’t expect this in-optimal operation is inherited from Rel-16 and beyond. Having this capability reported will help ensure the target peak rate in typical scenarios are guaranteed/controled without artificially sacrificed.With newly added proposal from section 4, 5-35 may be clarified to be for UE processing capability 1.**1 Avoid defining “incapability” bits as they may cause interpretation issues**The definition of the capability should not say that “a UE setting the bit does not support Rel-16 feature X”. Such statements caused a lot of problems in Rel-15. One example was the *pucch-F0-2WithoutFH* that indicates that “the UE does **not** support PUCCH formats 0 and 2 without frequency hopping”.  |
| Ericsson | For the proposed FG [5-35], the “Consequence if the feature is not supported by the UE” says “gNB is not expected to configure CBG operation and multiple PDSCHs per slot simultaneously”. This contradicts the functionality that a UE indicates via 5-22 (CBG support) and e.g. 5-11 (support multiple TBs/slot), where such UE can be configured with CBG and multiple TBs/slot. Thus, the proposed FG [5-35] is adding an additional new incapability indication in Rel-16 for functionality the UE has already indicated as being supported via Rel-15 signaling (e.g. 5-22 + 5-11). It is also not clear how optimal/inoptimal is related to the new [5-35] as there is no description in component expect for the reference to a conclusion in the note. Given this, the purpose of new FG and its implication on existing capability signaling is not clear. We propose to not introduce new capability for simultaneously enabling of CBG and multiple PDSCHs per slot. |
| Nokia/NSB | We do not see the need for the new FG 5-35. Similar to the other FGs above, we believe that more technical discussions are needed to understand the proposal, which go beyond the scope of this exercise. |
| Intel | We do not see the need for FG 5-35. Compared to Rel-15, in terms of combinations of FGs supported, 5-35 indeed seems like an “incapability indication”. Furthermore, the peak rate use case is mentioned as a motivating reason for FG 5-35. However, scheduling with multiple TBs in a slot is not aligned with the configuration we assumed for peak data rate calculation – thus, it has nothing to do with peak data rate. |

**FL proposal:**

* FG5-35 is removed (i.e., not introduced in Rel-16).

# **New FGs [11-3a]/ [11-3b]/ [11-3c]/ [11-3d]/ [11-3e]**

In [9], following new FGs are proposed.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 11-3a | CBG based transmission for UL with 1 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | CBG based transmission for UL with 1 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | 5-5a or 5-5b | Yes | N/A |  | Per UE | No | FR1 only |  | [Modification of Rel-15 capability] | Optional with capability signalling |
| 11-3b | CBG based transmission for UL with up to 2 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | CBG based transmission for UL with up to 2 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | 5-13 | Yes | N/A |  | Per UE | No | FR1 only |  | [Modification of Rel-15 capability] | Optional with capability signalling |
| 11-3c | CBG based transmission for UL with up to 7 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | CBG based transmission for UL with up to 7 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | 5-13a | Yes | N/A |  | Per UE | No | FR1 only |  | [Modification of Rel-15 capability] | Optional with capability signalling |
| 11-3d | CBG based transmission for UL with up to 4 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | CBG based transmission for UL with up to 4 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | 5-13c | Yes | N/A |  | Per UE | No | FR1 only |  | [Modification of Rel-15 capability] | Optional with capability signalling |
| 11-3e | CBG based transmission for UL with up to 3 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | CBG based transmission for UL with up to 3 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | 5-13d | Yes | N/A |  | Per UE | No | FR1 only |  | [Modification of Rel-15 capability] | Optional with capability signalling |

In Monday UE features session for URLLC/IIoT, following conclusion was made.

**Conclusion:**

Following is discussed in AI 7.2.11.13.

* Whether to introduce separate FGs for the simultaneous use of CBG-based UL transmission and minimum processing capability 2 (e.g., 11-3a/3b/3c/3d/3e)

## 4.1 Discussion 4

**Companies are encouraged to provide views on whether or not to introduce new FGs for the simultaneous use of CBG-based UL transmission and minimum processing capability 2 (e.g., 11-3a/3b/3c/3d/3e in [15]).**

 **Introducing new capabilities supported by:**

 **Objected (i.e., not introducing them) by:**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSi | Kind of supportive while wonder why only UL is proposed. |
| Ericsson | Is this the same ‘incapability’ as 5-35 discussed above? How about fpr Capability 1? |
| Nokia/NSB | These seem to be complementary to the suite of new FGs proposed as 5-35x. Unfortunately, even further discussion is needed to understand the scope and implications of these proposals, how they relate to each other, and which ones make sense independently. Hence we do not support it at this time. |
| Intel | These seem similar to the above FG 5-35, and similar questions arise on the need for these FGs. Further, it is not clear why it is specifically an issue for Capability 2 and for UL in particular. |

**FL proposal:**

* New FGs for the simultaneous use of CBG-based UL transmission and minimum processing capability 2 are not introduced in Rel-16.

# **Conclusion**

**FL proposal:**

* Updated FG8-1 is kept (i.e., Rel-16 UEs are required to set the capability bit for FG8-1 to 1).

**FL proposal:**

* FG5-11c/12c/13g/13h are removed (i.e., not introduced in Rel-16).

**FL proposal:**

* FG5-35 is removed (i.e., not introduced in Rel-16).

**FL proposal:**

* New FGs for the simultaneous use of CBG-based UL transmission and minimum processing capability 2 are not introduced in Rel-16.

TBD

# **References**

[1] R1-2001484 RAN1 UE features list for Rel-16 NR after RAN1#100-E Moderator (AT&T, NTT DOCOMO, INC.)

[2] R1-2001634 Remaining issues on Rel-16 NR UE features ZTE

[3] R1-2001742 Discussion on the support of SRS transmission in all symbols of a slot OPPO

[4] R1-2002026 On UE feature list Intel Corporation

[5] R1-2002159 UE features for other aspects Samsung

[6] R1-2002281 Potential change/update on existing UE features for Rel-16 UE Ericsson

[7] R1-2002656 High-level discussion on Rel-16 UE features Futurewei

[8] R1-2002674 Other aspects of Rel-16 UE features Huawei, HiSilicon

[9] R1-2002687 Discussion on UE features Qualcomm Incorporated

[10] RP-200502 Informational summary on email discussion: [Rel16\_UE\_capabilities] Exchange of views NTT DOCOMO, INC.