**3GPP TSG-RAN WG1 #106bis-e R1-21xxxxx**

**eMeeting, Oct 11 – 19, 2021**

**Source: Moderator (Ericsson)**

**Title: Summary of Email discussion [106bis-e-NR-DSS-01]**

**Agenda item:** **8.13.1**

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

# 1 Introduction

This document summarizes the discussions for email thread [106bis-e-NR-DSS-01] under agenda item 8.13.1 on Cross-carrier scheduling (from SCell to PCell) for the Rel17 WI on NR Dynamic spectrum sharing (DSS).

# 2. Discussion

## 2.1 Moderator Summary

Below is a short moderator summary based on tdocs [1-19] submitted for RAN1#106bis-e

### 2.1.1 PDCCH monitoring and BD/CCE limits

Following aspects were discussed related to PDCCH monitoring and BD/CCE limit handling when CCS from sSCell to PCell/PSCell is configured

#### 2.1.1.1 Type B BD/CCE limits

1. BD/CCE limit handling for Type B UE
   * [based on Option A/C] (from RAN1#106-e agreement) - [4],[6],[7],[8],[9],[13],[16],[17],[18],[19],[2](2nd pref),[3] (if M\_total based on Rel16)
     + Distribution of PDCCH BD candidates between multiple sSCell slots overlapping a P(S)Cell slot (Alt 1,Al2, Alt3 from RAN1#105-e agreement)
       - Alt1 – [2],[19]
       - Alt2 – [2],[4],[6],[7],[17]
       - Alt3 – [9],[18]
     + determining or
       - Scaling factors for (p-p) and (s-p) to count P(S)Cell from two scheduling cells – [2],[3],[8],[9]
       - (p-p) counted once with P(S)Cell SCS, (s-p) not counted – [2], [3],[5],[7],[9],[17]
       - (p-p) counted once with P(S)Cell SCS, (s-p) counted once with sSCell SCS – [17]
     + separate not needed
       - [4],[7],[8],[13],[18]
     + Issue related to UE is not required to monitor more than [ or ] PDCCH BD candidates per sSCell slot
       - * [8],[9],[18]
         * [5],[19]
     + Use for P(S)Cell overbooking procedure -[8],[9]
   * [based on Option C] (from RAN1#106-e agreement) - [1],[2],[5],[10],[12],[14],[15],[3](if M\_total not based on rel16)
     + Allowed combinations of s1 and s2
       - 1 ≤ s1+s2 ≤ 2 – [10, [12]
       - s1 + s2 1 – [2], [15]
   * Same framework for BD and CCE limits but separate scaling factors for CCE limits – [17]
2. Multi-TRP
   * can be supported with BD/CCE handling Option A or Option C – [2]
   * Rel-16 limits can be either directly reused or can be combined with PDCCH monitoring limits for sSCell to P(S)Cell scheduling with single-TRP – [8]
   * additional BD limitations apply for CORESETs with same coresetPoolIndex – [19]
3. Span based monitoring
   * can be supported with BD/CCE handling Option A or Option C – [2]
   * For case of different monitoringCapabilityConfig for the P(S)Cell and the sSCell, count the P(S)Cell as a scheduled cell for both scheduling cells – [8]

#### 2.1.1.2 Type A PDCCH monitoring and BD/CCE limits

1. PDCCH monitoring and BD/CCE limits
   * UE can simultaneously monitor sSCell USS (for PCell scheduling) and Type 0/0A/1/2/CSS for broadcast DCI on P(S)Cell. UE does not expect simultaneous scheduling with unicast DCI. Same BD/CCE handling as Type B UE is reused
     + [18], [17]
   * UE can simultaneously monitor sSCell USS (for PCell scheduling) and Type 0/0A/1/2/CSS on P(S)Cell. Same BD/CCE handling as Type B UE is reused
     + [2],[10],[17],[19], [11] (BD limit?),[12] (BD limit?)
     + [19] – separate definition for Type A not needed
   * Type 0/0A/1/2/CSS on P(S)Cell and sSCell USS (for PCell scheduling) can overlap but UE drops sSCell USS sets in overlapping [symbol/slot]
     + [1],[3],[4],[5],[6],[8],[9],[13],[15]
     + BD/CCE limit for respective cell is applied for a slot that a UE would monitor the corresponding PDCCH – [1]
     + BD/CCE limit based on Option B discussed earlier for Type B UE – [4]
     + No per-slot change in and – [8]
     + Avoiding setting a new blind decoding limits similar to Type B UEs – [13]
     + No proposal for BD/CCE limit – [5],[6],[9],[15]
   * Support same BD/CCE limit handling for Type and Type B -- [7],[3](?)
   * UE capability to monitor PDCCH on only one of P(S)Cell and sSCell in a slot (of smaller SCS) - [8]
   * UE drops Type3 CSS set(s) on PCell if it overlaps with USS set(s) for scheduling P(S)Cell on sSCell – [9]
2. Clarification on [slot/symbol] in RAN1#105e agreement
   * per slot (of P(S)Cell) overlap is avoided – [4], [9],[10]
   * overlapping search space condition is evaluated on a symbol basis – [19]
3. non-fallback USS handling (i.e.,
   * Type A Supports non-fallback DCI format on PCell – [2],[10]

#### 2.1.1.3 General

1. DCI format 2\_5
   * follows Rel16 – [2], [4],[15],[16],
2. DCI format 2\_6
   * Follows Rel16 handling – [2],[4],[9],[15],[16]
   * Can be sent also on sSCell – [10]
3. Use CIF for PCell non-fallback DCI when sSCell is configured – [2],[8],[12],[17],[18],
4. SCell to PCell scheduling for unaligned CA
   * Supported – [6],[10],[17]
5. SCell to PCell scheduling for multicast
   * Supported -- [8],[10]
   * FFS – [6],[3]
6. Handling when sSCell is deactivated/dormant/not available
   * Recovery of BD/CCE budget on P(S)Cell to the Rel-15/Rel-16 budget once sSCell is deactivated or switched to dormant BWP, Fallback to P(S)Cell self-carrier scheduling as if cross-carrier scheduling from sSCell to P(S)Cell is not configured – [2],[3]?,[6],[11],[14],[15],
   * Some USS(s) (for monitoring non-fallback DCI formats) configured on P(S)Cell are monitored when sSCell is deactivated/dormant/not available and not monitored when sSCell is activated – [1] (in case UE only monitors non-fallback DCI formats on sSCell), [4], [17],[19]
   * when sSCell is deactivated/dormant – [10]
   * UE (both Type A and Type B UE) monitors DCI formats 0\_1, 1\_1, 0\_2, 1\_2 on P(S)Cell as configured regardless of whether sSCell is activated or deactivated – [5],[12]
7. Impact on #DL and UL unicast DCI per monitoring occasion/span – [2],[9],[14],[17] (being discussed in UE features email discussion)
8. Do not support P(S)Cell SCS > sSCell SCS – [5], [7], [18]
9. Impact on DCI size budgets – [3]

### 2.1.2 Configuration details for CCS from sSCell to P(S)Cell

1. Search space linking configuration for CCS
   * Use SS linking as in Rel16
     + [2],[10],
   * Use SS linking but with some changes
     + PeriodicityAndOffset, SymbolsWithinSlot, and duration can be configured on linked PCell SS
       - [9]
     + PeriodicityAndOffset, SymbolsWithinSlot, and duration can be separate for sSCell self-scheduling and sSCell to P(S)Cell scheduling
       - [11],[18],[19] (at least monitoringSlotPeriodicityAndOffset)
     + if a SS set configuration includes only the IE for the number of candidates, UE monitors the SS set on sSCell. Otherwise (if a SS set configuration includes all the IEs required for monitoring), UE monitors the SS set on P(S)Cell
       - [12]
2. SCell to PCell scheduling configured per USS set -- [6],[15]
3. Separate config of UL and DL DCI formats – [17]
4. Clarify that *SearchSpace* configured on P(S)Cell having linked *SearchSpace* on sSCell in the same cell-group/PUCCH-group is not monitored on the P(S)Cell – [18]
5. RRC configuration details for CCS from sSCell to PCell/PSCell (How to indicate using CrossCarrierSchedulingConfig) – [8] (being discussed in RRC parameter email discussion)

### 2.1.3 Remaining details on scheduling framework

1. Dynamic activation/activation of sSCell to P(S)Cell scheduling – [2]
2. simultaneous replacement of a deactivated/dormant sSCell by a new sSCell, or DCI/MAC CE based indication of sSCell – [8],[14]?

### 2.1.4 Other aspects

1. SCell to PCell/PSCell scheduling has no impact on PUCCH or PUSCH/SRS for non-CA – [19]
2. Whether sSCell can be unlicensed band? – [14]
3. BFR/RLF enhancement? – [4]

Below are some proposals for discussion

## 2.2 Proposals

### Proposal 1

* At least for Type B UE, when the UE is configured for CCS from sSCell to P(S)Cell and when P(S)Cell SCS (μ) is less than or equal to sSCell SCS (μ1), and at least when UE is not provided monitoringCapabilityConfig for any cell
  + On P(S)Cell (for self-scheduling)
    - UE is not required to monitor more than PDCCH BD candidates per P(S)Cell slot
  + On sSCell (for cross-carrier scheduling to P(S)Cell)
    - UE is not required to monitor more than [ or ] PDCCH BD candidates per sSCell slot
    - UE is additionally not required to monitor more than PDCCH BD candidates per P(S)Cell slot
  + is based on RRC configuration
  + is used for P(S)Cell overbooking procedure
  + When determining and
    - P(S)Cell self-scheduling is counted by applying scaling factor s1
    - sSCell to P(S)Cell scheduling is counted additionally (assuming SCS of sSCell) by applying scaling factor s2
    - and are based on RRC configuration
      * FFS: additional constraints on s1 and s2 e.g., 1 ≤ s1+s2 ≤ 2 or s1 + s2 1
    - Note: is as in Rel16
  + UE capability/incapability indication for below to be discussed as part of UE features discussion
    - All search space configurations monitored on sSCell for cross-carrier scheduling to P(S)Cell are within a single span of 3 consecutive OFDM symbols within a duration spanning P(S)Cell slot
* Same approach as above is used for CCE limits
  + FFS: Separate vs. same RRC configured scaling factors (corresponding to , s1, s2) for BD and CCE limits.

Companies are requested to indicate their view on the above proposal in the Table below

|  |  |
| --- | --- |
| **Company Name** | **Comments (Proposal 1)** |
| Moderator notes | Above proposal taking into account discussions so far and inputs from different companies summarized in point 1 of section 2.1.1.1. |
| Apple | In princple, we are fine with proposal. We have the following comments   1. s1 and s2 needs to be based on the UE capability as well, i.e., NW cannot configure some value that is smaller than UE reported capability if we allow NW configuration |
| Qualcomm | We are not OK with the following part:   * + When determining and     - P(S)Cell self-scheduling is counted by applying scaling factor s1     - sSCell to P(S)Cell scheduling is counted additionally (assuming SCS of sSCell) by applying scaling factor s2     - and are based on RRC configuration       * FFS: additional constraints on s1 and s2 e.g., 1 ≤ s1+s2 ≤ 2 or s1 + s2 1     - Note: is as in Rel16   The WID of Rel-17 DSS has the following statement “*Note: The total PDCCH blind decoding budget should not be changed as a result of this work*”. In our understanding, this means that for a given CA configuration and a given *pdcch-BlindDetectionCA*, the total BD budget for each SCS is unchanged between “with” and “without CCS from sSCell to PCell/PSCell”.  For example, suppose a UE supports DL-CA with 1 CC using 15kHz, 1 CC using 30kHz, and 4 CCs using 120kHz with all self-scheduling and *pdcch-BlindDetectionCA* = 4. With this, the UE is not required to support , , . This can be kept unchanged if (s1, s2) = (1, 0). However, for the other combinations of (s1, s2), the UE is required to support different BD numbers for SCSs for the same DL-CA configuration with *pdcch-BlindDetectionCA* = 4 due to CCS from sSCell to PCell. For example, for (s1, s2) = (0.5, 0.5), the UE is required to support , , . For (s1, s2) = (1, 1), the UE is required to support , , . We do not think this is aligned with the WID. In addition, if we allow this, the UE cannot report the same value(s) of *pdcch-BlindDetectionCA* (and *pdcch-BlindDetectionMCG-UE* / *pdcch-BlindDetectionSCG-UE* for NR-DC) for the given DL-CA configuration without supporting more BDs for SCSs 15kHz and 30kHz.  Also, it is not clear why (s1, s2) can be RRC configurable. |
| Samsung | The proposal is generally in a good direction in our opinion – we have the following comments:   * For the first sub-bullet for sSCell, Rel-16 limit should be directly used, which is based on . Therefore, should be deleted. * In the bullet for determining and , the current wording applies to the case of different SCS. When P(S)Cell and sSCell have a same SCS, no scaling factor is needed – the scheduled cell (i.e., P(S)Cell) is counted only once for .   + When determining and if     - P(S)Cell self-scheduling is counted by applying scaling factor s1     - sSCell to P(S)Cell scheduling is counted additionally (assuming SCS of sSCell) by applying scaling factor s2     - and are based on RRC configuration       * FFS: additional constraints on s1 and s2 e.g., 1 ≤ s1+s2 ≤ 2 or s1 + s2 1     - When s1 and s2 are not configured, the UE sets s1 = ? and s2 = ? (allow for RRC to not provide s1 and s2 – it is not a mandatory signalling).     - Note: is as in Rel16   + When determining and , P(S)Cell is counted once for . |
| Intel | The FL proposal is [based on Option A/C]. however, our preference is to adopt [based on Option C]. We prefer to work on details on both solutions. After some necessary details are finalized, we can do further down selection.  Just share comments on [based on Option A/C], as discussed in our document [10], we prefer to handle PDCCH monitoring on P(S)Cell as cell + the PDCCH monitoring on sSCell as cell.   * + On P(S)Cell (for self-scheduling)     - UE is not required to monitor more than PDCCH BD candidates per P(S)Cell slot. is calculated assuming .   + On sSCell (for cross-carrier scheduling to P(S)Cell)     - UE is not required to monitor more than PDCCH BD candidates per sSCell slot. is calculated assuming .     - UE is additionally not required to monitor more than PDCCH BD candidates per P(S)Cell slot   On the other hand, for the current FL proposal, it should apply to sSCell, i.e.   * + - UE is not required to monitor more than ~~[ or ]~~ PDCCH BD candidates per sSCell slot   as discussed in Figure 1 in our document [10], the use of [ or ] may result in PDCCH decoding of cells, i.e., one cell with numerology of sSCell plus cell with numerology of P(S)Cell. |
| Xiaomi | We share the same views with Qualcomm. The newly introduced (s1, s2) combination will break the benchmark which is also analyzed in our contribution R1-2109390. One example is shown in the following table. It can be observed that if (s1,s2) is defined, the distributed BDs would be more than the benchmark limit for one group while less than the benchmark limit for another. We don’t think it is reasonable and should be avoided.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | –> PCell  –> sSCell | Based on option A/C | | Based on option C | | | | sSCell not counted | sSCell is counted | S1=1, S2=1 | S1=0.5, S2=1 | S1=1, S2=0.5 | | BD | 35 for  115 for | 29 for  120 for | 29 for  120 for | 14 for  120 for | 29 for  60 for | | CCE | 44 for  179 for | 37 for  186 for | 37 for  186 for | 18 for  186 for | 37 for  93 for | | Baseline: the total number of BD/CCE in current specification  BD for serving cells with : floor(4\*44\*1/5)= 35  BD for serving cells with : floor(4\*36\*4/5)= 115  Non-overlapped CCE for serving cells with : floor(4\*56\*1/5)= 44  Non-overlapped CCE for serving cells with : floor(4\*56\*4/5)= 179 | | | | | | |
| vivo | We share the same concern with Qualcomm that configurable s1 and s2 will result BD/CCE change before and after scell scheduling Pcell is configured. In our opinion, s1=1 and s2=0. Another missing part in the proposal is the PDCCH candidates for sScell scheduling Pcell will be subject to which total BD/CCE limit. From the discussion, it is apparently that the PDCCH candidates from sScell to Pcell are counted as scheduling cell withThere are the following two alternatives which also involves selection of [ or ]:   * Alt. a: the PDCCH candidates from sScell to Pcell are additionally counted as scheduling cell with sScell SCS that should follow 🡺 is selected * Alt. b: the PDCCH candidates from sScell to Pcell are not additionally counted as scheduling cell with sScell SCS 🡺 is selected.   One example is provided assuming 1 PCell with 15KHz SCS, 4 SCells S1-S4 with 30kHz SCS and 1 Scell S5 with 15KHz SCS. UE reports pdcch-BlindDetectionCA =4, , ==58 and ==96. Then the details on BD/CCE limit in difference cases are illustrated below:   * When sScell scheduling Pcell is not configured:  |  |  | | --- | --- | | Scheduling | PDCCH BDs | | P-P | b0<=44 per 1ms such that b0+b5 <= 58 | | S1->S1 | b1<=36 per 0.5ms such that b1+b2+b3+b4 <= 96 | | S2->S2 | b2<=36 per 0.5ms such that b1+b2+b3+b4 <= 96 | | S3->S3 | b3<=36 per 0.5ms such that b1+b2+b3+b4 <= 96 | | S4->S4 | b4<=36 per 0.5ms such that b1+b2+b3+b4 <= 96 | | S5->S5 | b5<=44 per 1ms such that b0+b5 <= 58 | |  | Total per 1ms  =b0+2\*(b1+b2+b3+b4)+b5<=58+2\*96=250 |  * When sScell scheduling Pcell is configured and Alt. a is used:  |  |  | | --- | --- | | Scheduling | PDCCH BDs | | P-P | b0<=alpha\*44= 22 per 1ms such that b0+b5+2\*b6 <= 58 | | S1->S1 | b1<=36 per 0.5ms such that b1+b2+b3+b4+b6 <= 96 | | S2->S2 | b2<=36 per 0.5ms such that b1+b2+b3+b4+b6 <= 96 | | S3->S3 | b3<=36 per 0.5ms such that b1+b2+b3+b4 +b6<= 96 | | S4->S4 | b4<=36 per 0.5ms such that b1+b2+b3+b4+b6 <= 96 | | S5->S5 | b5<=44 per 1ms such that b0+b5 +2\*b6<= 58 | | S1->P | b6<=36 per 0.5ms such that b1+b2+b3+b4+b6 <= 96  2\*b6<=beta\*44=22 per 1ms such that b0+b5+2\*b6<=58 | |  | Total per 1ms  =b0+2\*(b1+b2+b3+b4)+b5+2\*b6<=250-2\*b6 |  * When sScell scheduling Pcell is configured and Alt. b is used:  |  |  | | --- | --- | | Scheduling | PDCCH BDs | | P-P | b0<=alpha\*44= 22 per 1ms such that b0+b5+2\*b6 <= 58 | | S1->S1 | b1<=36 per 0.5ms such that b1+b2+b3+b4 <= 96 | | S2->S2 | b2<=36 per 0.5ms such that b1+b2+b3+b4 <= 96 | | S3->S3 | b3<=36 per 0.5ms such that b1+b2+b3+b4 <= 96 | | S4->S4 | b4<=36 per 0.5ms such that b1+b2+b3+b4 <= 96 | | S5->S5 | b5<=44 per 1ms such that b0+b5 +2\*b6<= 58 | | S1->P | b6<=36 per 0.5ms  2\*b6<=beta\*44=22 per 1ms such that b0+b5+2\*b6<=58 | |  | Total per 1ms  =b0+2\*(b1+b2+b3+b4)+b5+2\*b6<=250 |   Based on the above evaluation results, it is clearly observed that Alt. a would result in total BD decrease per 1ms after sScell scheduling P(S)cell is configured, while Alt. b maintains the same number of total BD. Since WID explicitly says “Note: The total PDCCH blind decoding budget should not be changed as a result of this work”, Alt. b should be supported to maintain the same total BD/CCE budget that is aligned with WID. |
| ZTE | Comments to the new Option A:  1) As also commented by other companies, s1=1 and s2=0 may be more appropriate;  2) Regarding the square brackets in the second sub-bullets, our understanding is that should be used. The principle of Option A is to split the BD/CCE from PCell to two parts, one for PCell self-scheduling and another part for sSCell scheduling PCell. This has nothing to do with the . In fact, including in the equation may be incorrect if is smaller than , in which case it will lead to even smaller BD/CCE budget compared with Rel-15 UE.  Comments to the previous Option C:  From our perspective, the previous [based on Option C] is a complete solution already. We can use it as baseline to compare the new Option A and Option C. |
| MTK | We support the FL proposal except that we prefer to set s1=1 and s2=0 as mentioned by QC, Xiaomi. If the s1/s2 values are still controversial, we can also accept to put the s1/s2 related paragraph in FFS. |
| Huawei, HiSilicon | We don’t agree on Option A (in short of Option A/C) as cannot see any technical benefits to adopt that so far. There were several comments raised during the GTW on why not Option C, however none is correct:  **1. Option A is the current mechanism while Option C is not, given that the BD capability is handled per scheduled cell?**  >>This is not accurate. Option C is more in line with the current specification that concerns the SCS of each scheduling cell, for a scheduled cell. Obviously in both Option A and Option C, there is only one scheduled cell – this is the same. However the quoted spec texts in [7] actually indicate that SCS of scheduling cell should be accounted for. Option A does not meet this.  **2. Option A has better flexibility as the BD distribution within one larger slot and Option C require split per slot?**  >>This is not accurate. As basic capability we would take slot based scheduling in most cases, then even in Option A the possible MO is limited to the first 3 OS within a slot. It cannot be floating within a slot everywhere. The flexibility does not exists unless span-based configuration is applied. But Option C can also do this.  **3. Option C with split of BD per slot is more complicated considering larger SCS scheduling smaller SCS, e.g. FR2???**  >> No. The handling per slot of scheduling cell using SCS of the scheduling CC is very similar to R16 higher SCS scheduling lower SCS, except for a scaling down operation, however this reduce the UE complexity. If preferred, the scaling factor can be disabled then it is the same as legacy for SCell. Needless to say it has nothing to do with FR2.  **4. Option A is more like CA framework while Option C is more about M-TRP?**  >> Not accurate. CA framework allows BD of SCell with different SCS, e.g. 30 kHz can have larger BD budget than the PCell with 15 kHz SCS. M-TRP does not allow different SCS between two TRPs so far. Option A disables that the BD on SCell can be as large as a UE should be capable of, since in Option A, the BD of SCell is determined as the remaining BD from PCell without considering different SCS. All the UE capability is considered as if there is only one scheduling cell, which is the PCell. In this sense, Option A is more like M-TRP with gamma=1 (total BD is the same as single cell, distributed by two scheduling points with the same SCS).  Also, if the total BD is the same as a single PCell, there is no benefit to use DSS – PCell self-scheduling is the same.  **5. What Option C can do but Option A cannot?**  >> Option A has problem that the derived BD on a slot of SCell overlapping with a slot of PCell may actually exceed the capability of BD on that SCell of R16, if the PDCCH on SCell are centralized to e.g. one edge of the slot.  Option A may also have problem to be directly applied to span-based PDCCH monitoring, since the spans among two cells with different SCS may not be aligned/matched, then it is not clear how to distribute the BD using reference SCS.  Obviously, Option A has fewer BD than Option C.  Additionally, Option A is incomplete – companies are keeping putting restrictions on Option A and deferring some details to UE feature discussion. It would be good to be explained why we cannot just take Option C which is more implementation friendly and more future proof. |
| Nokia, NSB | Although we do share similar view with Samsung, we would be OK and move forward with this proposal with s1=1 and s2=0.  Prefer to use the same RRC configured scaling factors for BD and CCE limits  For Alt.a/b for the PDCCH candidates, we prefer Alt. b (as well explained by vivo):   * the PDCCH candidates from sScell to Pcell are not additionally counted as scheduling cell with sScell SCS  is selected. |
| Intel2 | We agree with the analysis from Huawei  I’m not sure if I made my comments clear in the GTW session. The FL proposal 1 results in more than one cell for PDCCH decoding of P(S)Cell l. Let me repeat my comments using an extreme example. Such analysis generally applies to any scaling factor too.  It is 44 BD for PCell with SCS 15kHz. Assuming 8 BD are allocated to PDCCH on PCell and 36 BD are allocated to sSCell. The 36 BD may be cumulated into single sSCell slot. Then, the PDCCH detection on sSCell is exactly the decoding capability of one cell with SCS 30kHz. PDCCH detection on PCell can be considered as 8/44 cell. finally, the observation is that PCell is effectively modeled as 1 + 8/44 cells for PDCCH decoding.  On the other hand, assuming s1+s2=1 in Option C, the PDCCH monitoring for PCell is exactly modeled as one cell. therefore, we prefer Option C. |
| LG Electronics | We still prefer [based on Option C] which is a complete/clean solution and does not need further refinement different from [based on Option A/C] (as shown in other companies’ comments above).  If we go with [based on Option A/C] as in FL proposal 1, s1 and s2 need to be introduced for determining and , on the other hand, scaling factor or may not be necessary as Samsung commented. In addition, if companies have a concern on increment of a total BD/CCE budget (compared to PCell self-carrier scheduling), the concern can be handled by proper gNB’s configuration by setting s1 and s2 not to exceed the total BD/CCE budget. |
| ETRI | We prefer Option C which we consider is more aligned with Rel-15/16 principles. We also agree with LG that Option C is already a complete/clean solution. If we go with Option A/C, s1=1 and s2=0 is preferred. |
| CMCC | In general, we are fine with the proposal except the part about determining and . And we think fixed value of scaling factor s1=1 and s2=0 is more reasonable to calculate and as some companies analyzed previously. |

### Discussion Point 2

* Companies are encouraged to provide their view on the following on how to proceed for Type A UE
  + Possible Approach 1
    - All UEs (supporting cross-carrier scheduling from SCell to PCell) can simultaneously monitor ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell at least for broadcast DCI formats’
    - BD/CCE limits for Type B UEs are applicable for all UEs
    - Separate UE capability/incapability is introduced to indicate support/no support of simultaneous monitoring of ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell for unicast DCI formats’
  + Possible Approach 2
    - All UEs (supporting cross-carrier scheduling from SCell to PCell) can be configured with Type 0/0A/1/2/CSS sets on P(S)Cell that overlap with sSCell USS sets (for P(S)Cell scheduling)
    - Type A UEs drop the USS set(s) on sSCell (for P(S)Cell scheduling) that overlap in same [symbol/slot] as Type 0/0A/1/2/CSS sets on P(S)Cell
      * Separate UE capability is introduced for the Type A UEs
    - BD/CCE limit for Type A UE is based on one of the following approaches
      * Option B (discussed earlier for Type B UEs)
      * Option D
        + In a slot, if the PDCCH candidates are only configured on P(S)Cell, the BD/CCE limit on this slot is determined based on the P(S)Cell configurations
        + In a slot, if the PDCCH candidates are configured only on sSCell, the BD/CCE limit on this slot is determined based on the sSCell configurations
        + The limit of Rel-16 UE capability is applied without further restrictions
      * Option E
        + No per-slot change in and
  + Discuss further the following (this related to *“…DCI formats 0\_1,1\_1,0\_2,1\_2 (if supported for Type A UE).*.” part in RAN1#105e agreement and the WA from RAN1#104-e)
    - For Possible Approach 1
      * Whether UEs not supporting simultaneous monitoring of ‘Type 0/0A/1/2/CSS sets on P(S)Cell for unicast DCIs’ and ‘USS sets (for P(S)Cell scheduling) on sSCell’ support monitoring of non-fallback USS on P(S)Cell when configured for SCell to P(S)cell scheduling
    - For Possible Approach 2
      * Whether Type A UEs support monitoring of non-fallback USS on P(S)Cell when configured for SCell to P(S)cell scheduling
  + Note
    - ‘broadcast DCI formats’ implies DCI format(s) on Type 0/0A/1/2/CSS with CRC not scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI
    - ‘unicast DCI formats’ implies DCI format(s) on Type 0/0A/1/2/CSS with CRC scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI

|  |  |
| --- | --- |
| **Company Name** | **Comments (Discussion Point 2)** |
| Moderator notes | Above taking into account discussions so far and inputs from different companies summarized in point 1 of section 2.1.1.2.  Intention is to arrive at complete (or at least nearly complete) proposals on how to handle Type A UEs. Possible Approach 2 is based on Alt2 of Proposal 2v3 discussed in RAN1#106-e. Possible Approach 1 is based on Alt1/3 and the inputs on need for Type A UE if Alt2 is not supported (i.e., according to *“•FFS: Whether Type A is specified or is Type-B with restrictions (as part of UE features discussion)*” in RAN1#105-e agreement)  Please provide your view on above approaches including   * BD/CCE limit handling for Type A UE in Possible Approach 2 (Note - the listed approaches are based on inputs summarized in point 1 of section 2.1.1.2)   + For comparing the various options, P(S)Cell with 15kHz SCS and 1 or 4 SCells with 30kHz SCS can be used as an example scenario (same scenarios used in Type B UE discussions) * The discussion related to “…*DCI formats 0\_1,1\_1,0\_2,1\_2 (if supported for Type A UE)*..” part in RAN1#105e agreement and the WA from RAN1#104-e |
| Apple | I believe we agreed that fallback DCI can also be monitored on Type 0/0A/1/2/CSS sets because of the DCI size alignment and no additional UE complexity (only RNTI difference). We think we need more discussion about different proposals |
| Qualcomm | We are OK with possible approach 1 (with compromise for the additional UE capability/incapability in the 3rd bullet).  We are not OK with possible approach 2, especially for “BD/CCE limit for Type A UE”. Unlike Proposal 1 (for Type-B UE), the listed options B/D/E are incomplete, and the interactions with the UE behavior on “dropping USS set(s) on sSCell” and with the for each SCS for a given DL-CA configuration and the reported value of *pdcch-BlindDetectionCA* are unclear. |
| Samsung | Fine to proceed with Approach 2 (the first sub-bullet is redundant – implied by the second one). Determination of overlap should be on slot level (for the smallest SCS between P(S)Cell and sSCell).  BD/CCE limits are based on Rel-16 – i.e. Option E. The P(S)Cell is a scheduled cell for both the P(S)Cell and the sSCell in every slot, regardless of search space set configuration in each slot. As in Rel-16, there is no re-computation of BD/CCE limits when, based on search space set configurations, a first scheduling cell is not active in a first slot and a second scheduling cell is not active in a second slot.  Approach 1 is no different from Type-B UEs, it only introduces arbitrary restrictions, and is not acceptable. |
| Intel | The approach 1 is based Alt 2 in early meeting with Alt 3 as UE capability. The additional complexity for Alt 3 over Alt 2 seems just CRC checking with C-RNTI in additional to SI/P/RA-RNTI. Therefore, we share Apple’s view such complexity is nothing. Therefore, our preference is to tune approach 1 based on Alt 3. There is no need for a capability for such minor complexity.  As to approach 2, we think it requires PDCCH decoding module of 2 cells for Type A UE. on the other hand, a Type A UE may only support s1+s2=1 cell PDCCH decoding capability. This is not reasonable since Type A UE is targeted low end UE type. |
| Xiaomi | Look through approach 1 and approach 2, I am little bit confused as the wording related to handling type 0/0A/1/2 CSS:  Approach 1: ‘Type 0/0A/1/2/CSS sets on P(S)Cell at least for broadcast DCI formats’. The intention is to include alt3 but we don’t think it should be the case for type A UE.  Approach 2: ‘Type 0/0A/1/2/CSS sets on P(S)Cell’, i.e. no restrictions on the DCI formats.  Considering we are discussing type A UE, it is already clear that UE does not monitor DCI scheduling PCell/PSCell on both sSCell and PCell/PSCell simultaneously. We share the same views with apple that there is no issue for a UE to simultaneously monitor DCI formats scheduling PCell/PSCell on sSCell and DCI formats scheduling broadcast on PCell/PSCell simultaneously. |
| vivo | We support possible approach 2. There is no much difference for Type A and Type B UEs if approach 1 is adopted. |
| ZTE | As we discussed online, for Possible Approach 1, the difference between Type A UE and Type B UE is not clear and it is not clear why we need to split it into two different types of UE.  For Possible Approach 2, the discussion may be lengthy considering that companies have different views on the Option B, Option D and Option E. Especially, Option D will result with dynamic change of BD/CCE budget per slot, which should be avoided.  Considering that, we would suggest to define the same UE behaviour for both type A and type B UE by following what we have for type B UE. However, we can define or configure different scaling factors type A and type B UE.  Regarding the *“…DCI formats 0\_1,1\_1,0\_2,1\_2 (if supported for Type A UE).*.” part in RAN1#105e agreement and the WA from RAN1#104-e, our understanding is that non-fallback DCI can be monitored on PCell as long as they are not overlapped with USS on sSCell scheduling PCell. |
| MTK | Same view as Samsung. We prefer Approach 2.  For BD/CCE limit handling of Type A UE in Possible Approach 2:   * Determination of overlap should be on slot level (for the smallest SCS between P(S)Cell and sSCell). * BD/CCE limits are based on Rel-16 – i.e. Option E. The P(S)Cell is a scheduled cell for both the P(S)Cell and the sSCell in every slot, regardless of search space set configuration in each slot. * As in Rel-16, there is no re-computation of BD/CCE limits when, based on search space set configurations, a first scheduling cell is not active in a first slot and a second scheduling cell is not active in a second slot.   There is no much difference for Type A and Type B UEs if approach 1 is adopted. |
| Huawei, HiSilicon | We are OK with approach 2. RNTI is not a differing factor for PDCCH monitoring. The intention of introducing Type A UE is not to monitor PDCCH on PCell and sSCell in overlapping time and is already reflected. For the BD/CCE limit for Type A UE with approach 2, both Option D and Option E are OK. |
| Nokia, NSB | Share the Intel view, tuning the approach 1 to be based on Alt 3. |
| LG Electronics | We prefer Approach 2 in order to differentiate Type A UE from Type B UE. If we select Approach 1, it may eventually imply that we won’t define Type A UE. |
| ETRI | We agree with Intel. Prefer to modify Approach 1 to reflect Alt 3 more precisely. |
| CMCC | We are fine with the Possible Approach 2. The illustration in Possible Approach 2 makes the behavior of Type A UE just similar to Type B UE. We prefer Approach 2 that clearly distinguish the two types of UE. |

### Proposal 3 (for conclusion)

* When sSCell to PCell cross-carrier scheduling is configured, DCI format 2\_6 (if configured) is monitored only on P(S)Cell

Companies are requested to indicate their view in the Table below

|  |  |
| --- | --- |
| **Company Name** | **Comments (Proposal 3)** |
| Moderator notes | Above proposal taking into account inputs from different companies (summarized as point 2 in section 2.1.1.3) |
| Apple | We are fine with the proposal |
| Qualcomm | We are fine with the proposal. |
| Samsung | OK with the proposal. |
| Intel | OK with the proposal. |
| Xiaomi | We are fine with the proposal. |
| vivo | We are fine with the proposal |
| ZTE | We are fine with the proposal |
| MTK | We are fine with the proposal |
| Huawei, HiSilicon | Y |
| Nokia, NSB | We are fine with the proposal |
| LG Electronics | Support |
| ETRI | We are fine with the proposal. |
| CMCC | We are fine with the proposal |

### Proposal 4

* When CIF for sSCell to PCell cross-carrier scheduling is configured, non-fallback DCI formats on P(S)Cell include same number of CIF bits as the corresponding non-fallback DCI formats on sSCell that are used for sSCell to P(S)Cell scheduling

Companies are requested to indicate their view in the Table below

|  |  |  |
| --- | --- | --- |
| **Company Name** | **Support/ Not support** | **Comments (Proposal 4)** |
| Moderator notes |  | Above proposal taking into account inputs from different companies (summarized as point 3 in section 2.1.1.3) |
| Apple |  | We are fine with the proposal |
| Qualcomm | Support |  |
| Samsung | Support |  |
| Intel | Support | As one step further, we can decide on the value of CIF field in the non-fallback DCI on P(S)Cell. Our preference is to use same CIF value for P(S)Cell as used by sSCell. However, we are open to other alternatives. |
| Xiaomi |  | OK |
| vivo | Support |  |
| ZTE | Support | We also need to finalize the value of CIF for PCell self-scheduling. From our perspective, CIF=0 can be used in this case. |
| MTK | Support | Same view as ZTE |
| Huawei, HiSilicon | N | Could explain a bit more why this is needed? Our understanding is the intention is to keep DCI size budget. However, there seems to be other fields likely not aligned. So does this really matter? |
| Nokia, NSB |  | OK, but does it matter? |
| LG Electronics |  | We need a clarification on what is the consequence of not taking Proposal 4. According to DCI size alignment specified in 212, in case DCI size budget allocated for C-RNTI for PCell is exceeded, UE will add padding bits for non-fallback DCI on PCell to be aligned with non-fallback DCI on sSCell (scheduling PCell). If this is the case, we may not need to additionally include CIF for non-fallback DCI on PCell.  In addition, if CIF can be included in non-fallback DCI on PCell, it should be clarified whether CIF value in non-fallback DCI (scheduling PCell) on sSCell is the same with CIF value in non-fallback DCI on PCell or not. |
| ETRI | Support | Agree with Intel and ZTE that the value of CIF can be decided together. |
| CMCC | Support | We think that how RRC signalling configures the CIF value, e.g., the CIF is configured per USS sets to differentiate which USS sets is used as self-scheduling and which USS sets is used as cross-carrier scheduling can be further discussed. |

### Proposal 5 (for conclusion)

* A UE configured for cross-carrier scheduling from SCell to P(S)Cell can also be configured with unaligned CA (i.e., using *ca-SlotOffset* )

Companies are requested to indicate their view in the Table below

|  |  |
| --- | --- |
| **Company Name** | **Comments (Proposal 5)** |
| Moderator notes | Above proposal taking into account inputs from different companies (summarized as point 4 in section 2.1.1.3) |
| Apple | We are open to discuss, maybe to introduce separte UE capability. |
| Qualcomm | There are two aspects: (1) unaligned CA between P(S)Cell/sSCell and another cell, or (2) unaligned CA between P(S)Cell and sSCell. We are OK with the first aspect.  For the second aspect, we would like to see if there is a practical use-case for this feature. Even if there is, since the second aspect requires additional UE complexity (two scheduling cells for the same scheduled cell are unaligned), we would like to conclude Proposal 1 and Discussion Point 2 above firstly. |
| Samsung | OK in principle with the proposal. Although DSS is not Rel-16 CA, allowing for different (larger) SCS for the sSCell is not fundamentally different than supporting unaligned CA. |
| Intel | We are OK with FL proposal |
| vivo | We are fine with the proposal |
| ZTE | We are fine with the proposal |
| MTK | We are generally fine with the proposal while sharing similar concern as QC. Maybe this can be discussed after Proposal 1 and Discussion Point 2. |
| Huawei, HiSilicon | Y |
| Nokia, NSB | We are in principle OK with the proposal with the assumption that this does not lead to any L1 spec impact. |
| ETRI | We are fine with the proposal. |
| CMCC | We are fine with the proposal. |

### Proposal 6

* For a UE configured for cross-carrier scheduling from sSCell to P(S)Cell, when sSCell is deactivated, a mechanism to support monitoring of additional PDCCH monitoring candidates/DCI formats on P(S)Cell is supported
  + The additional PDCCH monitoring candidates/DCI formats are not monitored on P(S)Cell when sSCell is activated
  + FFS whether the additional PDCCH monitoring candidates/DCI formats are in
    - additional SS set(s) that are not monitored on P(S)Cell when sSCell is activated
    - SS set(s) that are monitored on P(S)Cell when sSCell is activated

Companies are requested to indicate their view in the Table below

|  |  |
| --- | --- |
| **Company Name** | **Comments (Proposal 6)** |
| Moderator notes | Above proposal taking into account inputs from different companies (summarized as point 6 in section 2.1.1.3)  Note: The issue related to “…*DCI formats 0\_1,1\_1,0\_2,1\_2 (if supported for Type A UE)*..” part in RAN1#105e agreement and the WA from RAN1#104-e is being discussed as part of Discussion point 2. |
| Apple | We are not sure about the motivation.  The WI is motivated or justified by assuming that gNB needs sSCell to offload the PDCCH monitorin. Now we are discussing shifting PDCCH monioting from sSCell back to SpCell. We are not sure if there is any real issue in deployment anymore.  We think this should be a low priority thing. |
| Qualcomm | We do not think this is necessary. For both Type-A and Type-B, monitoring unicast PDCCH (both fallback and non-fallback DCI formats) on P(S)Cell is ensured even when sSCell is deactivated. Network can activate the sSCell by a PDSCH on P(S)Cell scheduled by unicast PDCCH whenever necessary. |
| Samsung | No need for the proposal.  For Type-B UEs, it is clearly redundant (and Rel-17 also supports SSSG switching).  For Type-A Ues, the proposal is also unnecessary as deactivation of the sSCell means low scheduling activity for the UE and RRC reconfiguration, if any, is fine.  It would be more meaningful to discuss replacement of the sSCell because of deteriorating link (UE mobility, interference, cell loading, beam failure, …). |
| Intel | The discussion here can apply to sSCell dormancy too. Better to make it clear in the main bullet.  We prefer to separate the discussion into two aspects   1. Whether additional USS sets are monitored on P(S)Cell when sSCell is deactivated 2. Whether max BD/CCE division among P(S)Cell and sSCell is changed when sSCell is deactivated   Our understanding is 2) is even beneficial when no additional USS sets as 1) are configured. I mean, due to the PDCCH overbooking on P(S)Cell, some configured USS sets on P(S)Cell are dropped since only part of PDCCH monitoring capability is assigned to PDCCH monitoring on P(S)Cell, i.e. controlled by or s1 in [option A/C] or [option C]. if we increase the share of max BD/CCE assigned to P(S)Cell after sSCell deactivation/dormancy, at least the dropped USS sets can become useful.  On the other hand, we prefer to allow 1) too. In any case, we think it is beneficial to guarantee the scheduling performance for P(S)Cell  b.t.w. it is better for FL to clarify the relation between the 1st sub-bullet and the 2nd sub-bullet under FFS. These two seems conflict each other. |
| Xiaomi | We share the same views with above companies. Which Scell is configured as the scheduling Scell for Pcell/Scell depends on gNB. Which Scell is deactivated is also depends on Scell. It is wired to say network want to migrate the PDCCH on Pcell/PSCell to sSCell while decide to deactivate the sSCell. |
| Vivo | We support the proposal. When P(S)cell is configured to be scheduled by a sScell, a typical configuration for P(S)cell self-scheduling is CSS only with no USSs or very sparse USSs. Consequently, after the sScell becomes deactivated or dormant, it would be very difficult to schedule the UE due to very limited scheduling opportunities. RRC reconfiguration is needed to configure more USSs. However, this RRC reconfiguration may occur in sparse CSS or USS which results in large delay. By this proposal, it avoids frequent RRC reconfiguration and large scheduling delay when sScell becomes deactivated or dormant.  Besides, another issue should be also discussed: what’s the BD/CCE calculation mechanism when sScell becomes deactivated or dormancy, normal one as in R15 or R16 or the one used when sScell scheduling Pcell is configured> |
| ZTE | We support the proposal.  This proposal can also be applicable to the case when sSCell is in dormant BWP.  The configuration of sSCell scheduling Pcell is RRC-level. However, the Scell activaton/deactivation and Scell dormancy indication is by MAC-CE and DCI, respectively. Once the sSCell is deactivated or switched into dormant BWP, a mechanism is needed to resume UE’s BD/CCE capability to legacy one. Otherwise, network has to perform frequent RRC reconfiguration, which will incur unnecessary delays. |
| MTK | We are generally fine with the FL proposal. The application delay of additional PDCCH monitoring activation may need to be further investigated. |
| Huawei, HiSilicon | Support. There is use case that network want to deactivate it. Enabling this feature is because of deployment need or spectrum limitation, however whether or not to (de-)activate it should depend on use cases and could be more dynamic and real-time. |
| Nokia, NSB | We support the proposal and agree that it should apply to both deactivated and dormant sSCell case. Not supporting this proposal could lead to network not exploiting Dormant SCell or deactivating the SCell leading to higher UE battery consumption when CCS is configured. |
| LG Electronics | Support. We think additional PDCCH monitoring on PCell (when sSCell is deactivated or in dormant state) is beneficial in terms of PDCCH capacity increase even in DSS scenario. For example, gNB can opportunistically utilize additional PDCCH monitoring on PCell if possible (such as low load situation), in case sSCell is deactivated or in dormant state. |
| ETRI | Support the proposal. It may be beneficial to decide non-fallback DCI monitoring on USS set in P(S)Cell together or earlier. |
| CMCC | Support, we think if sSCell is deactivated, UE should fallback to Rel-16 CA behaviour, which all USS sets can be monitored on P(S)Cell. |

### Proposal 7

* For UEs configured with sSCell to P(S)Cell scheduling
  + For the linked search space in the scheduled cell (P(S)Cell), additional IEs under the IE SearchSpace other than searchSpaceId and nrofCandidates can be present,
    - The additional IEs include monitoringSlotPeriodicityAndOffset, duration, monitoringSymbolsWithinSlot
    - The additional IEs provide the configuration for PDCCH monitoring on sSCell (for P(S)Cell scheduling)

Companies are requested to indicate their view in the Table below

|  |  |  |
| --- | --- | --- |
| **Company Name** | **Support/ Not support** | **Comments (Proposal 7)** |
| Moderator notes |  | based on inputs summarized in point 1 of section 2.1.2 |
| Apple |  | Then we need some machanism to toggle the interpretation, i.e., which SS set should UE check for those additonal IEs.  Even though we agree that the current CCS configuration in terms of SS set configuration is not the most desirable, but if we change it, we prefer to change to for CCS as a whole instead of just the sSCell. |
| Qualcomm | Support | It should be clear that this proposal is only for the linked search space set(s) in P(S)Cell and in sSCell using the same search space set index. |
| Samsung |  | This was already discussed and concluded in RAN1 #106-e.  If the discussion is to open again, we prefer to have a clean solution having separate configuration of search space sets for sSCell self-scheduling compared to P(S)Cell scheduling. We don’t agree to keep patching things up with partial changes to search space linking procedure. |
| Intel | Not support | There is no problem for the existing NR design of cross-carrier scheduling. Therefore, the additional IEs include monitoringSlotPeriodicityAndOffset, duration, monitoringSymbolsWithinSlot for the PDCCH monitoring on sSCell is not necessary.  On the other hand, we prefer to clarify how to identify a SS set configured for self-scheduling on P(S)Cell and a SS set configured for CCS on sSCell. |
| Xiaomi |  | We are OK with the proposal. We agree with Apple that it should not be restricted to sSCell. However, it would be a little bit out of scope if we apply the mechanism to general CCS scenarios as it is not DSS. We would like to hear more views from companies. |
| vivo |  | This is a general cross carrier scheduling issue not motivated by DSS. Suggest to deprioritize. |
| ZTE |  | We are ok with this proposal if it can be generalized to all CA cases instead of just for DSS. |
| MTK | Support | We support the FL proposal. |
| Huawei, HiSilicon |  | Same view as Samsung.  It is less preferable to have partial update/enh. with limited benefits but require implementation change. This can be considered in future releases as a whole. |
| Nokia, NSB | Support | Its preferrable to configure SearchSpace set parameters separately for self-scheduling and cross-carrier scheduling.  We support to introduce additional IEs to the linked search-space or to identify a mechanism to identify SS configured for self-scheduling and cross-carrier scheduling. |
| LG Electronics | Not support | As in our Tdoc R1-2109987, we propose to configure whether each USS set configured for PCell is monitored on PCell or sSCell, per USS set index, which does not require any additional IEs to indicate monitoring pattern on sSCell. |
| ETRI | Not support | For SS set configuration monitored on sSCell, we think that the legacy SS set linking mechanism is sufficient. |
| CMCC | Support | It is necessary to differentiate which USS sets is used as self-scheduling and which USS sets is used as cross-carrier scheduling from sSCell, and we think the additional IEs can used to indicate it. |

# 3 Conclusions

TBD

# 4 References

1. R1-2108773 Discussion on SCell PDCCH scheduling P(S)Cell PDSCH or PUSCH Huawei, HiSilicon
2. R1-2108855 Discussion on Cross-Carrier Scheduling from SCell to PCell ZTE
3. R1-2108929 Discussion on cross-carrier scheduling from SCell to Pcell Spreadtrum Communications
4. R1-2109005 Discussion on Scell scheduling Pcell vivo
5. R1-2109098 Discussion on cross-carrier scheduling from Scell to Pcell OPPO
6. R1-2109306 Discussion on cross-carrier scheduling from SCell to Pcell CMCC
7. R1-2109390 Discussion on cross-carrier scheduling from SCell to PCell Xiaomi
8. R1-2109518 Cross-carrier scheduling from SCell to PCell Samsung
9. R1-2109551 On Cross-Carrier Scheduling from sSCell to P(S)Cell MediaTek Inc.
10. R1-2109636 On SCell scheduling PCell transmissions Intel Corporation
11. R1-2109704 Discussion on cross-carrier scheduling enhancements for NR DSS NTT DOCOMO, INC.
12. R1-2109820 Discussion on cross-carrier scheduling from SCell to Pcell ETRI
13. R1-2109895 Discussion on cross carrier scheduling from sSCell to PCell InterDigital, Inc.
14. R1-2109938 Cross-carrier scheduling (from Scell to Pcell) Lenovo, Motorola Mobility
15. R1-2109987 Discussion on cross-carrier scheduling from SCell to Pcell LG Electronics
16. R1-2110059 Views on Rel-17 DSS SCell scheduling PCell Apple
17. R1-2110141 Enhanced cross-carrier scheduling for DSS Ericsson
18. R1-2110213 Cross-carrier scheduling from an SCell to the PCell/PSCell Qualcomm Incorporated
19. R1-2110376 On cross-carrier scheduling from SCell to Pcell Nokia, Nokia Shanghai Bell

# 5 Annex A – Agreements from previous meetings

## Agreements from RAN1#102-e

Agreements:

* Following scheduling combinations are allowed/not allowed when cross-carrier scheduling from an SCell to PCell/PSCell is configured  
  1. self-scheduling on PCell/PSCell is allowed
  2. cross-carrier scheduling from PCell/PSCell to another SCell is not allowed
  3. self-scheduling on the ‘SCell used for scheduling PCell/PSCell’ is allowed
  4. cross-carrier scheduling from the ‘SCell used for scheduling PCell/PSCell’ to another serving cell is allowed
  5. cross-carrier scheduling from another serving cell to the ‘SCell used for scheduling PCell/PSCell’ is not allowed
* FFS: Search space and DCI format handling for the allowed cases above

Agreements:

* Configuring 2 or more Scells to schedule the PCell/PSCell is not allowed

## Agreements from RAN1#103-e

**Conclusion**

* When CCS from sSCell to PCell/PSCell is configured, the configuration of Type 3 CSS set for DCI formats 2\_0, 2\_1, 2\_2, 2\_3, 2\_4 and applicability of the information in the DCI formats are the same as in Rel-15/Rel-16
  + FFS: DCI format 2\_5 and DCI Format 2\_6 handling
* Note: The SCell configured with CCS to Pcell/PSCell is referred to as ‘sSCell’

**Conclusion**

* When the PCell/PSCell and sSCell use different numerologies, the PDSCH reception preparation time between the PDCCH on the sSCell and the PDSCH on the PCell/PSCell is applied (i.e., as specified in TS38.214 Section 5.5).

Agreements:

* When CCS from an SCell (sSCell) to PCell/PSCell is configured, UE monitors Type 0/0A/1/2 CSS sets (for the DCI formats associated with those SS sets) only on the PCell/PSCell and not on the sSCell
  + Note: UE monitors Type 0/0A/2 CSS only on PCell while Type 1 CSS can be monitored on PCell/PSCell

Agreements:

* Discuss in RAN1#104-e how to handle ‘DCI formats 0\_1,1\_1,0\_2,1\_2 scheduling PDSCH/PUSCH on PCell/PSCell’ from USS set(s), when CCS from sSCell to PCell/PSCell is configured.. Below alternatives can be considered in the discussion (other alternatives are not precluded)
* ~~Below alternatives can be considered in the discussion (other alternatives are not precluded)~~
  + Alt 1: ~~When CCS from sSCell to PCell/PSCell is configured,~~ UE cannot be configured to monitor DCI formats 0\_1,1\_1,0\_2,1\_2 on PCell/PSCell USS set(s), and can be configured to monitor them only on the sSCell USS set(s)
  + Alt 2: ~~When CCS from sSCell to PCell/PSCell is configured,~~ UE can be configured to monitor DCI formats 0\_1/1\_1/0\_2/1\_2 on PCell/PSCell USS set(s), and/or on sSCell USS set(s). The PDCCH monitoring is based on following alternatives (other alternatives are not precluded)
    - Alt 2-1:
      * UE can monitor DCI formats 0\_1,1\_1,0\_2,1\_2 on both PCell USS set(s) and sSCell USS sets simultaneously
        + ~~FFS activation/deactivation of scheduling from sSCell to PCell/PSCell~~
    - Alt 2-2:
      * Dynamic switching of PDCCH monitoring of DCI formats 0\_1,1\_1,0\_2,1\_2 between monitoring on PCell/PSCell USS sets and monitoring on sSCell USS sets is supported
        + FFS: Details of switching mechanism (~~e.g. based on SS group switching, based on BWP switching,…~~)
      * UE does not monitor DCI formats 0\_1,1\_1,0\_2,1\_2 on both PCell USS set(s) and sSCell USS sets simultaneously
    - Alt 2-3:
      * UE does not monitor the same DCI format on both PCell USS set(s) and sSCell USS sets simultaneously. UE can monitor some DCI formats on sSCell USS sets and other DCI formats on PCell/PSCell USS sets simultaneously
    - Alt 2-4:
      * The USS set(s) on PSCell/PCell and the USS set(s) on sSCell are configured such that UE does not monitor DCI formats 0\_1,1\_1,0\_2,1\_2 on both PCell USS set(s) and sSCell USS set(s) simultaneously
* FFS following aspects
  + Impact of sSCell activation/deactivation and sSCell dormancy
  + Impact on BD/CCE limit handling ~~including considering PDCCH monitoring on CSS sets and PDCCH monitoring of ‘DCI formats 0\_0, 1\_0 scheduling PUSCH/PDSCH on PCell/PSCell’~~
  + Whether PDCCH overbooking on sSCell is supported or not supported and impact (if any) on overbooking handling on PCell/PSCell
  + Impact from different numerologies between PDCCH on the PCell/PSCell and that on the sSCell
  + Whether or not to have mechanism for activation/deactivation of scheduling from sSCell to PCell/PSCell
  + USS configuration details (e.g. handling of USS type (self-scheduling, cross carrier scheduling) for a ~~configured~~ USS set configured for scheduling of ~~in~~ PCell/PSCell)

## Agreements from RAN1#104-e

**Agreement**

When CCS from sSCell to PCell/PSCell is configured,

* Out of order scheduling is not allowed between a) PDSCH on PCell/PSCell scheduled by PDCCH on PCell/PSCell and b) PDSCH on PCell/PSCell scheduled by PDCCH on sSCell
* Out of order scheduling is not allowed between a) PUSCH on PCell/PSCell scheduled by PDCCH on PCell/PSCell and b) PUSCH on PCell/PSCell scheduled by PDCCH on sSCell

FFS: Whether this agreement requires RAN1 specification impact.

**Agreement**

When CCS from sSCell to PCell/PSCell is configured,

* Simultaneous reception of a) unicast PDSCH on PCell/PSCell scheduled from PCell/PSCell and b) unicast PDSCH on PCell/PSCell scheduled from sSCell is not allowed
* Simultaneous transmission of a) PUSCH on PCell/PSCell scheduled from PCell/PSCell and b) PUSCH on PCell/PSCell scheduled from sSCell is not allowed
* Note: Simultaneous implies full/partial time overlapping

FFS: Whether this agreement requires RAN1 specification impact.

**Agreement**

* When CCS from sSCell to PCell/PSCell is configured, CA activation/deactivation operation for the sSCell is supported

**Working Assumption**

* When CCS from sSCell to PCell/PSCell is configured, UE can be configured to monitor DCI formats 0\_1/1\_1/0\_2/1\_2 that schedule PDSCH/PUSCH on PCell/PSCell on PCell/PSCell USS set(s), and/or on sSCell USS set(s)
* The WA to be confirmed after agreements are made on PDCCH BD/CCE handling and PDCCH overbooking handling for CCS from sSCell to PCell/PSCell
* Specs also allow UEs supporting functionality of only Alt-1. Capability signaling details, if any, can be handled during the UE capability discussion for Rel17
* FFS: Whether the UE can monitor PDCCH from both cells in the same slot.

**Agreement**

* When CCS from sSCell to PCell/PSCell is configured, UE monitors ‘DCI formats 0\_0 and 1\_0 in CSS that schedule PDSCH/PUSCH on PCell/PSCell’ only on the PCell/PSCell and not on the sSCell

## Agreements from RAN1#104b-e

**Agreement**

* When CCS from sSCell to PCell/PSCell is configured
  + CIF=0 used for sSCell self-scheduling, and CIF for sSCell to PCell cross-carrier scheduling is explicitly configured using RRC signalling

**Agreement**

PDCCH overbooking on sSCell USS set(s) is not allowed

Following was captured in RAN1 Chairman notes

**For RAN1#105-e, companies are encouraged to consider:**

* Further discuss PDCCH monitoring and BD/CCE limit handling in RAN1#105e considering below BD/CCE limit handling options
  + Option A
    - At least when P(S)Cell SCS is not higher than sSCell SCS, PDCCH monitoring candidates on P(S)Cell and/or sSCell are configured such that max of (x1(m1)+x2(m1))+max of y(m2) corresponding to any P(S)Cell slots m1 and m2 is less than or equal to Z1
    - At least the case of Z1 = 44 is supported for P(S)Cell SCS 15kHz
      * FFS if Z1 larger than above can also be supported based on UE capability (e.g. similar to *BDFactorR* in Rel16)
    - FFS signalling details on how the limit Z1 is realized, e.g.
      * RRC configured BD limit/scaling factor-based limit for max(x1(m)+x2(m))
      * Separate RRC configured BD limits/scaling factor-based limits for max(x1(m)+x2(m)) and max(y(m))
      * separate BdfactorR for P(S)Cell and sSCell
      * SS configuration-based BD limit for max(x1(m)+x2(m)) and max(y(m))
      * RRC configured BD limit/scaling factor-based limit for max(x1(m)+x2(m))+ max(y(m))
      * Counting ‘sSCell-to-P(S)Cell’ scheduling as an additional scheduling cell with numerology given by sSCell numerology in determining the BD/CCE limits
    - FFS reference SCS to use when P(S)Cell has higher SCS than sSCell (if supported)
    - For sSCell scheduling P(S)Cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the sSCell more than PDCCH candidates per slot of sSCell.
      * FFS how limit is computed and applied when CCS from sSCell to P(S)Cell is configured
  + Option B
    - At least when P(S)Cell SCS is not higher than sSCell SCS, For P(S)Cell slot m, PDCCH monitoring candidates on P(S)Cell and/or sSCell are configured such that x1(m)+x2(m)+y(m) is less than or equal to BD limit Z2
    - At least the case of Z2 = 44 is supported for P(S)Cell SCS 15kHz
      * FFS if Z2 larger than above can also be supported based on UE capability (e.g. similar to *BDFactorR* in Rel16)
    - max of (x1(m1)+x2(m1)) + max of y(m2) corresponding to any P(S)Cell slots m1 and m2 ~~can~~ is allowed to be larger than BD limit Z2
    - FFS signalling details on how the limit Z2 is realized
    - FFS reference SCS to use when P(S)Cell has higher SCS than sSCell (if supported)
    - For sSCell scheduling P(S)Cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the sSCell more than PDCCH candidates per slot of sSCell.
      * FFS how limit is computed and applied when CCS from sSCell to P(S)Cell is configured
  + Option C
    - PDCCH monitoring candidates on P(S)Cell are configured such that max of (x1(m1)+x2(m1)) is less than or equal to Z3
      * Z3 is derived by the PDCCH monitoring capability of PCell
    - PDCCH monitoring candidates on sSCell are configured such that max of y(m2) is less than or equal to Z4
      * Z4 is derived by the PDCCH monitoring capability of sSCell
    - FFS details to define Z3 and Z4, e.g.
      * Separate RRC configured BD limits/scaling factor-based limits for max(x1(m)+x2(m)) and max(y(m))
    - For sSCell scheduling P(S)Cell, the UE is not required to monitor on the active DL BWP with SCS configuration of the sSCell more than Z4 PDCCH candidates per slot of sSCell
  + Note
    - x1(m) is #BDs for PDCCH CSS(s) candidates monitored on P(S)Cell slot m
    - x2(m) is #BDs for PDCCH USS(s) candidates monitored on P(S)Cell slot m
    - y(m) is #BDs for PDCCH USS(s) candidates monitored on sSCell in all sSCell slot(s) that overlap slot m of P(S)Cell
    - USS(s) => USS(s) that can schedule PDSCH/PUSCH on P(S)Cell)

## Agreements from RAN1#105-e

**Agreement**

Two types of UEs (Type A and Type B) can support CCS from sSCell to P(S)Cell

* For Type A UE
  + At least following search space sets on P(S)Cell and search space sets on sSCell are configured so that the UE does not monitor them in overlapping [slot/symbol] of P(S)Cell and sSCell
    - search space sets on P(S)Cell
      * USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2 (if supported for Type A UE)
      * USS sets for DCI formats 0\_0,1\_0
      * Type3-CSS set(s) for DCI formats 1\_0/0\_0 with C-RNTI/CS-RNTI/MCS-C-RNTI
    - search space sets on sSCell
      * USS set(s) for scheduling P(S)Cell
  + FFS: BD/CCE handling
* For Type B UE
  + Following search space sets on P(S)Cell and search space sets on sSCell can be configured so that the UE monitors them in overlapping [slot/symbol] of P(S)Cell and sSCell
    - search space sets on P(S)Cell
      * USS sets for DCI formats 0\_0,1\_0
      * Type3-CSS set(s) for DCI formats 1\_0/0\_0 with C-RNTI/CS-RNTI/MCS-C-RNTI
    - search space sets on sSCell
      * USS set(s) for scheduling P(S)Cell
  + For handling ‘USS sets for scheduling P(S)Cell’ on P(S)Cell and/or on sSCell for DCI formats 0\_1,1\_1,0\_2,1\_2
    - Alt 2-1 is adopted
  + There is no restriction on Type-0/0A/1/2-CSS sets configurations
  + FFS: BD/CCE handling
* For Type A and/or Type B UE
  + FFS: switching to ‘normal’ PDCCH monitoring on P(S)Cell when sSCell is deactivated
* FFS: Whether Type A is specified or is Type-B with restrictions (as part of UE features discussion)
* FFS: Whether the UE can be configured with unaligned CA
* FFS: Whether the above applies for multicast PDSCH

**Discuss further in RAN1#106-e:**

* For at least Type B UE, downselect from one of the BD/CCE limit handling options below
  + [based on Option A/C] When UE is configured for CCS from sSCell to P(S)Cell and when P(S)Cell SCS () is less than or equal to sSCell SCS ()
    - On P(S)Cell (for self-scheduling)
      * UE is not required to monitor more than PDCCH BD candidates per P(S)Cell slot
      * UE is not required to monitor more than
        + Alt1

PDCCH BD candidates per P(S)Cell slot

* + - * + Alt2

PDCCH BD candidates per P(S)Cell slot

* + - On sSCell (for cross-carrier scheduling to P(S)Cell)
      * UE is not required to monitor more than PDCCH BD candidates per slot of sSCell
      * UE is not required to monitor more than
        + Alt1

PDCCH BD candidates per P(S)Cell slot

* + - * + Alt2:

PDCCH BD candidates per P(S)Cell slot

* + - At least case of is supported.
      * FFS case of
      * FFS multi-TRP case
    - FFS following
      * Selection between Alt1 vs. Alt2 above
      * Whether separate and are configured by RRC or if and only is configured
      * How the PDCCH BD candidates are distributed between multiple sSCell slots overlapping a P(S)Cell slot when and whether the BD limits for sSCell are specified per sSCell slot or per P(S)Cell slot
  + [based on Option B] When UE is configured for CCS from sSCell to P(S)Cell and when when P(S)Cell SCS () is less than or equal to sSCell SCS ()
    - On P(S)Cell (for self-scheduling)
      * UE is not required to monitor more than PDCCH BD candidates per slot of P(S)Cell
    - On sSCell (for cross-carrier scheduling to P(S)Cell)
      * UE is not required to monitor more than PDCCH BD candidates per slot of sSCell
    - Considering both PDCCH BD candidates for P(S)Cell self-scheduling on P(S)Cell and PDCCH BD candidates for sSCell to P(S)SCell cross-carrier scheduling on sSCell
      * UE is not required to monitor more than
        + Alt 1

PDCCH BD candidates per P(S)Cell slot

* + - * + Alt 2

PDCCH BD candidates per P(S)Cell slot

* + - FFS: selection between Alt-1 and Alt-2
  + FFS: whether/how the definition of or is modified compared to Rel16 when UE is configured with CCS from sSCell to P(S)Cell

## Agreements from RAN1#106-e

**Agreement**

Specification supports dormant BWP operation on sSCell for a UE is configured CCS from sSCell to P(S)Cell.

Agreement

* When CCS from sSCell to P(S)Cell is configured for a UE
  + at least the number of PDCCH monitoring candidates monitored on sSCell (for scheduling P(S)Cell) is indicated to the UE using the SS set linking approach as in Rel16
  + ~~FFS: If any modifications to Rel16 approach are introduced for~~ *~~monitoringSlotPeriodicityAndOffset, monitoringSymbolsWithinSlot, duration~~* ~~for the PDCCH monitoring candidates monitored on sSCell (for scheduling P(S)Cell)~~

Agreement

* At least for Type B UE, when the UE is configured for CCS from sSCell to P(S)Cell and when P(S)Cell SCS () is less than or equal to sSCell SCS (), and at least when UE is not provided monitoringCapabilityConfig for any cell, down select one from [based on Option A/C] or [based Option C] below
  + [based on Option A/C]
    - On P(S)Cell (for self-scheduling)
      * UE is not required to monitor more than PDCCH BD candidates per P(S)Cell slot
    - On sSCell (for cross-carrier scheduling to P(S)Cell)
      * UE is not required to monitor more than [ or ] PDCCH BD candidates per sSCell slot (Note: this is assumed per Rel16)
      * UE is additionally not required to monitor more than PDCCH BD candidates per P(S)Cell slot
    - and are based on RRC configuration and at least cases o~~f~~ are supported
    - FFS the following for [based on Option A/C]
      * Distribution of PDCCH BD candidates between multiple sSCell slots overlapping a P(S)Cell slot including whether the above additional BD limitation is defined per sSCell slot or per P(S)Cell slot.
        + Discuss further using following alternatives as starting point (other alternatives/further refinement of alternatives not precluded)

Alt1

The additional BD limitation is per sSCell slot with further limitation that UE is not required to monitor more than PDCCH BD candidates per sSCell slot

Alt 2

The additional BD limitation is per P(S)Cell slot and no further restrictions

Alt 3

The additional BD limitation is per P(S)SCell slot with below further limitation

All search space configurations monitored on sSCell for cross-carrier scheduling to P(S)Cell are within a single span of 3 consecutive OFDM symbols within a duration spanning P(S)Cell slot

* + - * Whether/how the definition of or is modified compared to Rel16 when UE is configured with CCS from sSCell to P(S)Cell
      * Whether separate and are configured by RRC or if and only is configured
  + [based on Option C]
    - On P(S)Cell (for self-scheduling)
      * UE is not required to monitor more than PDCCH BD candidates per P(S)Cell slot
    - On sSCell (for cross-carrier scheduling to P(S)Cell)
      * UE is not required to monitor more than PDCCH BD candidates per sSCell slot
    - When determining and
      * P(S)Cell self-scheduling is counted by applying scaling factor s1,
      * sSCell to PCell scheduling is counted additionally (assuming SCS of sSCell) by applying scaling factor s2
    - and
    - FFS the following
      * + Allowed combinations of s1 and s2 , and whether they are fixed or configured via RRC
        + Whether/how the definition of or is modified compared to Rel16 when UE is configured with CCS from sSCell to P(S)Cell
* FFS the following
  + Multi-TRP handling
  + PDCCH BD handling when monitoringCapabilityConfig = r16monitoringcapability is configured for any cell

**Agreement**

* Endorse below TP to 38.300 from RAN1 perspective
* Send LS to RAN2 with the TP and list of RAN1 agreements, to update Stage 2 spec are needed to reflect the RAN1 agreements

----------------------------------------- start TP1 for 38.300 v.xyz -------------------------------------------

10.8 Cross Carrier Scheduling

Cross-carrier scheduling with the Carrier Indicator Field (CIF) allows the PDCCH of a serving cell to schedule resources on another serving cell but with the following restrictions:

- ~~Cross-carrier scheduling does not apply to Pcell i.e~~. When cross-carrier scheduling from an SCell to Pcell is not configured, Pcell can only be ~~is always~~ scheduled via its PDCCH;

- When cross-carrier scheduling from an SCell to Pcell is configured, PDCCH on that SCell can schedule Pcell’s PDSCH and PUSCH, and PDCCH on the Pcell can also schedule Pcell’s PDSCH and PUSCH, and PDCCH on Pcell cannot schedule PDSCH and PUSCH on any other cell. Only one SCell can be configured to be used for cross-carrier scheduling to Pcell;

- When an SCell is configured with a PDCCH, that cell’s PDSCH and PUSCH are always scheduled by the PDCCH on this SCell;

- When an SCell is not configured with a PDCCH, that SCell’s PDSCH and PUSCH are always scheduled by a PDCCH on another serving cell;

- The scheduling PDCCH and the scheduled PDSCH/PUSCH can use the same or different numerologies.

--------------------------------------------------- end TP1 -----------------------------------------------

Draft LS [R1-2108576](file:///C:\Users\Docs\R1-2108576.zip) is endorsed in principle

Final LS [R1-2108662](file:///C:\Users\Docs\R1-2108662.zip) is endorsed