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

**eMeeting, Oct 11 – 19, 2021**

**Source: Moderator (Ericsson)**

**Title: Summary#3 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 specificationBD for serving cells with : floor(4\*44\*1/5)= 35BD for serving cells with : floor(4\*36\*4/5)= 115Non-overlapped CCE for serving cells with : floor(4\*56\*1/5)= 44Non-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 <= 962\*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 limitsFor 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 HuaweiI’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. |
| OPPO | Our preference is Option C. Option A (formerly Option A/C) could be acceptable to us if the following changes are made: * The proposal is re-formulated with s1=1 and s2=0, as suggested by chairman in GTW.
* For the following sub-bullet:

“UE is additionally not required to monitor more than PDCCH BD candidates per P(S)Cell slot” It would be more gNB-beneficial and UE-implementation friendly to count the complexity per sSCell slot, i.e., “UE is additionally not required to monitor more than PDCCH BD candidates per sSCell slot”. With the previous upper-bound per P(S)Cell, it seems the UE could have many ways to distribute the total BD budget to each sSCell slot. For example, the UE is not required to monitor more than 10 in a P(S)Cell slot which overlaps with 2 sSCell slots. How to distribute this BD budget in each of two sSCell slots? The bound set by UE for each sSCell slot is unknown to gNB, which may increase the gNB’s uncertainty of scheduling outcome.* For the following bullet:
	+ 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

We wonder whether it is premature to mention number “3”. It seems better to remove “3” from the bullet. |
| NTT DOCOMO | We are fine with the proposal with s1=1 and s2=0. |
| Ericsson1 | We are OK with Proposal 1. Also OK with setting s1=1 and s2=0. On Option A vs. Option C* The main difference is Option C results in more BDs than Option A (as also mentioned by HW). With Option C, UE will have to support more than 44BDs for P(S)Cell scheduling while Option A ensures that the 44 limit is not exceeded across slots.
* Option A (like Option C) also has per slot limits (i.e., the Rel16 ‘per slot of scheduling cell’ limits are not exceeded). The difference is there is additional constraint on top of the Rel16 limits to enforce the <=44BDs constraint.
* Which Option looks more like Rel16 m-TRP or Rel15 CA is a bit moot point in our view. Both Options are different from current specs. Current specs do not support N+1 scheduling combinations of {scheduling cell, scheduled cell} when N cells are configured.
* If <=44BDs per P(S)Cell slot is an important constraint for UE implementation, then Option A is the suitable alternative. If this is not a constraint, either Option works. As mentioned in GTW, an implementation that can handle Option C (i.e., >44BDs) should be able to handle Option A.

On [ or ] discussion, in the examples from Vivo, it is unclear to us which part of the proposal results in blue highlighted part below. Can Vivo please clarify?

|  |  |
| --- | --- |
| Scheduling |  PDCCH BDs |
| P-P | b0<=alpha\*44= 22 per 1ms such that b0+b5+2\*b6 <= 58 |

 |
| Vivo2 | @Ericsson: The blue highlighted part is BD count for S1->P in terms of Pcell slot. For scheme based option A, BD for S1->P should be subject to ==58 in terms of Pcell slot. In the example, it means total BD of P->P, S5->S5 and S1->P in terms of Pcell slot should not be larger than i.e. b0+b5+2\*b6<=58. Actually, how to apply when sScell scheduling Pcell is configured is missing in this proposal. Thus we propose to add the following bullet into the proposal:* + When applying and
		- UE is not required to monitor more than PDCCH candidates for scheduling cells with Pcell SCS and sScell scheduling Pcell per Pcell slot

UE is not required to monitor more than PDCCH candidates for scheduling cells with sScell SCS 1 |

### Proposal 1v2

* 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 [Option A] or [Option C] below
	+ [Option A]
		- 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
			* s1=1 and s2=0
			* ~~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.
	+ [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 are based on RRC configuration
			* FFS: additional constraints on s1 and s2 e.g., 1 ≤ s1+s2 ≤ 2 or s1 + s2 1
		- ~~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~~

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

|  |  |
| --- | --- |
| **Company Name** | **Comments (Proposal 1v2)** |
| Moderator notes2 | Updated to Proposal 1v2 to reflect discussion from GTW and comments for proposal 1.For [Option A] -updated to s1=1 and s2=0 per GTW discussion and added square brackets around 3 based on Oppo comment. For [Option C] – based on inputs received for this meeting, perhaps the FFS bullet from RAN1#106-e agreement can be modified as updated. Please check and comment.On Option A vs. Option C discussion, there is not much change in company preferences. On [ or ] discussion for Option A, more companies (among those who commented) seem to prefer but additional discussion seems to be useful. |
| LG Electronics | We support [Option C]. It is obvious that [Option C] is clearer than [Option A].@ Ericsson: We disagree that UE will have to support more than 44BDs for P(S)Cell with Option C. For s1<1, UE is not required to monitor more than 44.If the main concern for [Option C] is 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 and we can add a NOTE, as follows:* [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 are based on RRC configuration
		- FFS: additional constraints on s1 and s2 e.g., 1 ≤ s1+s2 ≤ 2 or s1 + s2 1
	+ UE does not expect the total BD/CCE budget will exceed the total budget based on Rel-16 specification.
 |
| MTK | We are fine with Proposal 1v2 and prefer Option A. As mentioned by moderator, on Option A vs. Option C discussion, there is not much change in company preferences. We should find a way to pick one and move on. |
| Apple | We prefer Option A |
| Nokia, NSB | We are fine with Proposal 1v2 and would prefer option A. As commented by MTek, we should squeeze out a decision in this meeting, there is little help in additional rounds of debate |
| Xiaomi | One general question for the updated proposal: comparing to the agreement achieved in the last meeting, the progress is a little bit pessimistic as only some details are updated. Down-selection between two options is needed anyway. I am wondering what the plan on this issue is.Regarding to option A and option C, we prefer option A. Regarding to HW’s response, we have different understanding. Either option A or option C provides some detail solution for BD/CCE distribution among cells. Although the PCell/PSCell is scheduled via two serving cells, there is only one scheduled PCell/PSCell. Distributing BD/CCEs among serving cells from perspective of scheduled cell is reasonable. In the current specification, the BD/CCE limit is defined per scheduled cell. From this point of view, option A is align with the current procedure. On the other hand, option C is actually distributing BD/CCE from scheduling cell perspective, which is not desired. As mentioned by several companies, also analyzed in our contribution, option C would result in an unbalanced situation for BD/CCE distribution for the cell groups including PCell/PSCell and sSCell respectively.The current formulation of option A is fine to us. We also support vivo’s suggestion of determining the BD upper bound per sSCell slot. |
| ETRI | We are fine with the proposal and OK with either Option A or Option C (still prefer Option C).For Option A, for the square bracket part, we also prefer given that s2=0. And s1 and s2 can now be removed in the FFS of the last bullet (about CCE limit).For Option C FFS part, we prefer to allow s1+s2>1 to allow flexibility to boost the PDCCH capacity for P(S)Cell. |
| ZTE | Regarding the comparison between Option A and Option C, our first preference is Option C considering that it is more aligned with legacy operation, where BD/CCE budget is determined per PCell slot on PCell and per sSCell slot on sSCell. We can also accept Option A for progress.Regarding [ or ], our understanding is . As we commented previously, 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.Regarding “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”, we don’t think this UE capability is needed at all since it will make PDCCH off-loading to sSCell inefficiently and difficult to use. But we can accept to further discuss this in UE capability session. |
| vivo | We are fine with the proposal. Among Option A or Option C, both of them works technically and we have no strong view. However, if looking at current WID which explicitly says “Note: The total PDCCH blind decoding budget should not be changed as a result of this work”, Option A could achieve this while Option C is hard to do so. Considering this, we suggest to respect WID and select Option A to move on.Regarding the bracket, as we commented in 1st round, should be selected to maintain the same total BD/CCE budget.Besides, how to apply when sScell scheduling Pcell is configured is missing in this proposal. Thus we propose to add the following bullet into the proposal:* + When applying and
		- UE is not required to monitor more than PDCCH candidates for scheduling cells with Pcell SCS and sScell scheduling Pcell per Pcell slot

UE is not required to monitor more than PDCCH candidates for scheduling cells with sScell SCS 1 |
| Samsung | We prefer Option A and also want to support s1=s2=1 for different SCS. Although s1 = 1 and s2 = 0 works fine for same SCS, s1=s2=1 is better for different SCS as the BDs/CCEs will decrease on the P(S)Cell and increase on the sSCell while keeping the total BD/CCE budget as in Rel-16 and make DSS more meaningful for different SCS that is a main scenario – the “offloaded” BDs/CCEs on the sSCell (for P(S)Cell scheduling) can be part of and that can avoid an impact to Rel-16 specifications. Regarding comparison between Option A and Option C, here are some note:* Option C is drafted with less constraints than Option A and states the BD/CCE allocation on the sSCell per sSCell slot only. That may appear as a “clean” solution but it does not maintain the Rel-16 BD/CCE budget for the scheduled cell (P(S)Cell). The UE may monitor more BD/CCE that Rel-16 for P(S)Cell scheduling (setting s1<1 does not resolve this). Companies have tried to address this issue with additional notes such as “UE does not expect the total BD/CCE budget will exceed the total budget based on Rel-16 specification”, but such text is generic, not a complete solution. Option C is a “clean” solution simply because it is not a full solution.
* With respect to “Obviously, Option A has fewer BDs than Option C”, once suitable constraints are added to address the comment above, Option C actually leads to a smaller total BD/CCE budget compared to Option A (and to Rel-16), as shown for example by Xiaomi for various (s1, s2) combinations. Basically, Option C penalizes PDCCH monitoring for other serving cells.
* With respect to “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 has set a constraint to ensure Rel-16 limit applies to PDCCH monitoring on the sSCell.
* With respect to “in Option A, the BD of SCell is determined as the remaining BD from PCell without considering different SCS”, since Option A considers the offloaded BD/CCE per PCell slot, the different SCSs are accounted for. However, we are fine to have the PDCCH offloading in Option A be expressed as , instead of ], which will be based on the sSCell SCS and be somewhat more flexible.
* With respect to “Option A may also have problem to be directly applied to span-based PDCCH monitoring”, there is no reason to target designs for URLLC and DSS with LTE-NR coexistence is not geared towards URLLC (neither are the objectives of the DSS WI).
 |
| Qualcomm | We are OK with the FL proposal.We prefer Option A. Regarding [ or ], we think is reasonable. Suppose a following scenario: DL-CA with 4 CCs (15kHz) + 4 CCs (30kHz) + 2 CCs (120kHz) where the UE reports *pdcch-BlindDetectionCA* = 4 and no cross-carrier scheduling is supported/configured. For the above scenario, consider to introduce cross-carrier scheduling from a sSCell to PCell. The process capability for BDs/CCEs should not be increased – should be taken by existing BDs/CCEs.Using is as following. The process capability of BDs/CCEs for CCS from sSCell to PCell can be taken by either 15kHz CC group or by 30kHz CC group. It is up to UE implementation which to take them.Using is as following. The process capability of BDs/CCEs for CCS from sSCell to PCell is supposed to be taken by 15kHz CC group, not by 30kHz CC group. This offers less implementation choice for the UE. In addition, it is not clear whether the BDs/CCEs for CCS from sSCell to PCell cannot be shared with 30kHz CC group. If we go with , we have to clarify that the BDs/CCEs for CCS from sSCell to PCell are not sharable with the other 30kHz CCs.Regarding Option C, we have the same understanding with Xiaomi that it increases the BD/CCE limits and causes a serious issue. Increasing M\_total for a same SCS CC group for the reported *pdcch-BlindDetectionCA* for the given DL-CA configuration requires hardware impact. Also, we do not think PDCCH monitoring (for CCS from sSCell to PCell/PSCell) on every sSCell slot is part of the basic feature. For a basic UE supporting “slot-based PDCCH monitoring”, Option C limits BDs/CCEs on sSCell unnecessary. |
| Ericsson2 | We continue to support Option A.Thanks Vivo for the clarification. The example tables in your comment are not fully aligned with Option A under discussion. Given current Option A text has been stable for quite some time we prefer to not make further changes. |
| Huawei, HiSi | It is true that from BD capability point of view, a UE being able to do Option C is able to do Option A since the latter is lower-end. However for the current operation, the question is fundamentally why the 44 budget of BD in PCell is important for PDCCHs from sSCell and that needs to be addressed. The current spec concerns each SCS of the scheduling cell and Option C follows that. A UE implemented as previous release is supposed to be able to do that as well. “for each scheduled cell” does not matter between Option A and Option C as both for the case of one scheduled cell. For potential future enhancements, if the Option A is adopted, it is not clear how it works for * the case of lower SCS scheduling larger SCS, since the reference slot is a slot with shorter duration than that in SCell, and the BD needs be split in the SCell as well, however the boundary of split BD in SCell may also not match the CORESET/CSS configurations within that SCell slot
* the case of span-based PDCCH monitoring, since the spans across carriers are not boundary aligned

From our side, we don’t want to change our implementation to generate a lower end UE in order to support DSS, if we can already to do better. We also do not prefer complicated restriction/scheduling from network side. However, now we are considering whether the baseline is a UE supporting CA without cross-carrier scheduling or a UE supporting cross-carrier scheduling. For the former case, it might be ok to consider Option A since it only concerns single SCell effectively. For the latter case, which is our original thinking, SCell should be considered separately. We also noticed the relevant discussion in UE feature about which is the baseline. This may be relevant that needs to be firstly considered. |
| Intel | We support Option C. The existing NR determines the max BD/CCE based on the scheduling cell. This is reasonable design since PDCCH is exactly transmitted on the scheduling cell. The same principle should be applied in DSS. Since 2 scheduling cells (P(S)Cell and sSCell) are configured for P(S)Cell, the SCS of both scheduling cells should be considered in the PDCCH monitoring for PCell. However, Option A is effectively only derived the max BD/CCE by only one scheduling cell, i.e. P(S)Cell. As also discussed by other companies, Option C can allow more BD/CCE since there are two sSCell slots in a P(S)Cell slot. Note: it is still effectively one cell PDCCH monitoring capability given s1+s2=1. This is a beneficial property. Due to the hard split of max BD/CCE (common principle of Option A and C), it is impossible to share the CCE channel estimation between P(S)Cell and sSCell. Therefore, enforcing total 44/56 BD/CCE actually results in worst scheduling flexibility than legacy self-scheduling of PCell. With Option C, it allows more BD/CCE (in extreme case, it is 36x2=72 versus 44). This will mitigate the short of CCE in the PDCCH monitoring on two scheduling cells. Further, Option C is already a complete proposal. s1/s2 is used to respectively scale or . s1/s2 is used to respectively calculate or . That is all the details. On the other hand, for Option A, still multiple details are pending, e.g. the following sub-bullet * UE is not required to monitor more than [ or ] PDCCH BD candidates per sSCell slot

For the above issue of Option A, since ‘s1=1 and s2=0’ is proposed in another sub-bullet, is not related to PDCCH on sSCell for s-p scheduling. Consequently, is not reasonable. is problematic too, since it allows PDCCH monitoring on sSCell (s-p) to be the capability of one whole cell. Since PDCCH monitoring on P(S)Cell is modeled as cell, it is more reasonable to use as a limit to s-p scheduling on sSCell. * UE is not required to monitor more than ~~[ or ]~~ PDCCH BD candidates per sSCell slot
 |
| Moderator Notes3 | Thanks for the additional comments. Suggest to focus further discussion towards down-selection between Option A and Option C as captured in the Proposal 1v2. Regarding further modifications proposed by LG (for Option C) and Vivo, Intel (for Option A), given current text has been extensively discussed among the companies, it perhaps better to avoid further changes at this point (the proposed changes do not seem to change company positions at this point). Any further refinements can be discussed after down-selection.  |
| MTK | Thanks for the good discussions. Hopefully we can have a down-selection in the upcoming GTW session. |
| vivo | @Ericsson2: Could you please clarify which part of the table is not aligned with current Option A? In our understanding, our table is quite aligned with Qualcomm’s understanding (thanks for very good illustration). For the proposed text, we are not proposing a modification to Option A but a missing part in current Option A, i.e. how to apply the total limit when configured number of cells exceeds N\_cell^caps. Like in Qualcomm’s picture, what BD/CCE will M\_Total includes (e.g. blue circle and green circle). Our proposed text is corresponding to the following part in 38.213 (see highlighted text and red text):If a UE - is configured with downlink cells for which the UE is not provided *monitoringCapabilityConfig,* or is provided *monitoringCapabilityConfig-r16* = *r15monitoringcapability* but not provided *coresetPoolIndex*, - with associated PDCCH candidates monitored in the active DL BWPs of the scheduling cell(s) using SCS configuration , where , and- a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor more than  PDCCH candidates or more than non-overlapped CCEs per slot on the active DL BWP(s) of scheduling cell(s) from the downlink cells.@Moderator: We are OK to discuss the above proposed text after down selection.@Qualcomm: Thanks for detailed clarification. We think the key idea of Option A is to use 15KHz CC group to handle BD/CCE for sScell scheduling Pcell since s1=1 and s2=0. Besides, 44 budget is separated in Pcell self-scheduling and sScell scheduling Pcell. Then it seems strange to use 30KHz CC group to handle sScell scheduling Pcell. On another hand, do you agree that the total BD/CCE budget per 1ms is decreased before and after sScell scheduling Pcell is configured? |

**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.  |
| OPPO | OK with approach 2 in principle.  |
| Ericsson1 | Regarding ‘Possible Approach 1’, as mentioned in GTW session, our view also is that further discussion on capability/incapability indications can happen as part of UE feature discussions. Regarding ‘Possible Approach 2’, our concerns are summarized below* One key principle is that it should be possible to schedule broadcast and unicast transmissions to the UE in the same Pcell slot. Type A+Alt2 removes this possibility. As a consequence, scheduling of broadcast transmissions (e.g. SI, paging) across all UEs in a e.g. FDD Pcell have to reprovisioned, i.e. they are constrained to follow the TDM pattern that is required to support sSCell USS for even a single TypeA+Alt2 UE.
* RACH procedure is impacted since RA-RNTI monitoring also has to follow a TDM pattern. It was suggested that a different BWP can be used for Type A UEs so that at least legacy UEs are spared the slower RACH, but this requires the NW to support different RACH timelines for different UEs in the same cell. It also assumes UE support of optional BWP capabilities for at least for some BWP0 configuration options.
* Then considering BD limits for the TypeA+Alt2 UEs, applying the Rel16 limits for (30kHz scheduling cell, 15kHz scheduled cell) would be as below. This is significantly higher complexity for Type A+Alt2 UE compared to Type B UE. Unless BD handling like Option A is also applied for Type A+Alt2 UE (which is not ‘based on Rel16’), it is not clear to us how such UEs are expected to result in a simpler implementation from BD handling perspective. TypeA+Alt2+Option A results in the worst possible combination (among all options discussed) from scheduling flexibility perspective (the Pcell can never be scheduled with 44BDs as shown below).

 * We also note that all UEs (including TypeA+Alt2) have to support ‘simultaneous monitoring of PDCCH on P(S)Cell and sSCell’ (i.e., no constraint on (p-p)+(s-s) scheduling). So, it is unclear how imposing a TDM constraint on just (p-p)+(s-p) results in significant UE complexity reduction. If the UE vendor argument is that ‘simultaneous processing of the detected unicast DCI formats from different scheduling cells’ is the reason for complexity and avoiding it can simplify implementation, it is already addressed by Possible Approach 1.

Overall, we are not OK with Possible Approach 2. We are open to supporting a simplified UE type compared to Type B, and OK with Possible Approach 1. |

### Proposal 2v2-1

* Down-select from following approaches for PDCCH monitoring and BD limit handling 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 supporting cross-carrier scheduling from sSCell to P(S)Cell
		- Additional simplifications to PDCCH monitoring can be discussed during UE capabilities discussions including the following
			* Type A UE as per RAN1#105-e agreement and
				+ simultaneous monitoring of ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell’
			* Type A UE as per RAN1#105-e agreement and
				+ no simultaneous monitoring between ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell for DCI formats with CRC scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI’
				+ 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 DCI formats with CRC not scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI’
		- ~~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

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

|  |  |
| --- | --- |
| **Company Name** | **Comments (Discussion Point 2v2-1)** |
| Moderator Notes2 | Updated Possible Approach 1 based on comments and discussion in GTW session. Please provide further comments based on this proposal (e.g., how to further clarify the BD options for Possible Approach 2 as also discussed in GTW session.) |
| LG Electronics | Support the proposal and we prefer Approach 2. |
| MTK | We are fine with Proposal 2v2-1 and prefer Approach 2. For BD options for Possible Approach 2, the nice figures drawn by moderator seem correct but would still depend on which option (Option A or Option C) is adopted in Proposal 1v2.For issues of Approach 2 mentioned by Ericsson: 1. scheduling of broadcast transmissions (e.g. SI, paging) across all UEs in a e.g. FDD Pcell have to reprovisioned
2. RACH procedure is impacted since RA-RNTI monitoring also has to follow a TDM pattern

We are open to hear views from more companies. Besides, for the first issue, does it mean * UE has to monitor broadcast transmissions (e.g. SI, paging) in each slot for FDD Pcell?

For the second issue, since the RNTI is computed according to the formula in 38.321 we are wondering why this is an issue? |
| Apple | We are fine with Approach 1Our understanding of Approach 2 is that it is purely a TDM PDCCH monitoring between SpCell and sSCell which simply the specification initially. However, due to the Type B UE, 38.213 will need to handle BD/CCE as proposal 1 anyway. There might be some simplification to UE, but for sSCell with different SCS, the benefit is also questionable. Monitoring PDCCH on a single cell is not the same as monitoring PDCCH on two cells in TDM way, otherwise, we would not restrict that each scheduled cell can only have one scheduling cell in Rel-15. |
| Nokia, NSB | We’d be fine with Approach 1.For the record, UE monitoring cells in a TDM manner for scheduling maybe nice to implement on legacy platforms, but useless for the system and such a UE could just as well indicate no support for the feature. |
| Xiaomi | We support approach 1. Companies argued that approach 1 results in no difference between type A UE and type B UE, which we don’t agree. Type A UE and Type B UE are defined from the perspective whether it can monitor USS/Type3 CSS associated with C-RNTI/CS-RNTI/MCS-C-RNTI on Pcell/PSCell and SCell simultaneously. There is nothing about USS on SCell and type-0/0a/1/2 CSS when we define type A UE. For type A UE, we don’t think there is any issue to monitor USS on Pcell/PSCell and Type-0/0a/1/2 simultaneously.  |
| ETRI | We are OK with Approach 1. |
| ZTE | For progress, we can support the previous Alt.3, which is now under the first sub-bullet of the second bullet of Approach 1. If Approach 1 is selected, then RAN1 only needs to down-select one of the alternatives under the second bullet.However, if Approach 2 is selected, network may have to reconfigure the legacy SS configuration of SIB/Paging to avoid frequent dropping of USS set(s) on sSCell. Also, the discussion on Option B, Option D and Option E is time-consuming, which should be avoided as much as possible considering there is only one meeting left for Rel-17 RAN1. Also, it seems all the current Option B, Option D and Option E will cause dynamic change of BD/CCE from slot to slot, which should be avoided from our perspective. |
| Vivo | Support the proposal and prefer Approach 2. I don’t understand Ericsson’s concern on broadcast information and RACH. For Approach 2, only overlapping USS on sScell is dropped, there seems no impact on Pcell CSS monitoring. |
| Samsung | For approach 2:1. Type-3 CSS can be moved to sSCell (what is not moved, e.g. DCI 2\_6, does not matter).
2. SIB1 update is every 20 msec and SIBx>1 updates are less often. SIB scheduling is as in Rel-16 for DSS UEs. There is no NW constraint other than not scheduling from sSCell.
3. A search space set for RAR does not need to be same as for initial access and can be provided by *BWP-DownlinkCommon* (or can use the rule that UE prioritizes P(S)Cell when Mos overlap with ones on sSCell in a slot). There is no requirement that a UE supports multiple BWPs – it is only a BWP reconfiguration from the initial BWP and all UEs support it (needed to move away from the (small) initial BWP – can even be via SIB). There are no different timelines – NR allows for a maximum RAR window of 10 msec and that can be followed. There is no impact on legacy UEs.
4. Paging is similar to SIB.
5. Unicast scheduling is fully flexible and can occur from the P(S)Cell in slots where the sSCell is not applicable (there may not even be any as some slots on the sSCell will be UL ones).
6. Rel-16 PDCCH allocation applies – do not vary per slot. For the P(S)Cell as a scheduled cell, the number of BDs/CCEs may change per slot (in case of different SCS for the P(S)Cell/sSCell – no change for same SCS) but nothing changes with respect to the UE monitoring PDCCH from each scheduling cell (and UE monitors from only one cell in each slot) – the requirements are Rel-16 ones.

A Type-A UE can only be obtained with Approach 2. It has become commonly understood that Approach 1 is a Type-B UE and there is no reason to further consider as a UE capability. The suggested “simplifications” to PDCCH monitoring in the updated proposal are meaningless for a UE implementation and then having only a Type-B UE would be preferable as at least there would be benefit to the NW (handle only one UE type) since there is no benefit to the UE. There is no relevance to UE implementation if the RNTI is not allowed to be C-RNTI but is only allowed to be “UE-common” RNTI. There isn’t even such a thing as “UE-common” RNTI (or anything else) for a UE – everything is obviously UE-specific even if a configuration is by SIB. |
| Qualcomm | We are fine with the FL proposal.We support possible approach 1. We agree with FL assessment, Apple, Xiaomi, and ZTE. The parallel process for broadcast PDCCH and unicast PDCCH is different from the parallel/synchronous process for unicast PDCCHs on two cells for the same scheduled cell. So, approach 1 is quite different from Type-B UE.We do not think possible approach 2 works in reality. Possible approach 2 will cause non-trivial restriction on network operation/configuration. If the BD/CCE handling for possible approach 2 is different (more advanced) from that for Type-B UE, the two types will be exclusive features and then market fragmentation would be caused.  |
| Ericsson2 | We continue to support Approach 1. Agree with Nokia and Qualcomm comments that Approach 2 based UEs would not be suitable for a practical NW. Also, if Option E results in 44/72 BDs per P(S)Cell slot depending (p-p)/(s-p) we don’t think it can be considered a simplified UE compared to Type B.Regarding the comments from MTK, vivo – the text MTK cited is for RA-RNTI determination. RAR monitoring is in a sequence of slots following PRACH (RAR window). With TypeA+Alt2, only limited slots would have to be made available in the RAR window or there will be persistent USS dropping. |
| Huawei, HiSi | Fine with the current proposal. We previously indicated support of Approach 2 and can continue support it. We don’t prefer to use RNTI as differing factor as previously said. It is currently not related to any BD capability. The mentioned issue can be avoided by gNB implementation USS set is UE specifically configured for SCell. |
| Intel | We are fine with the proposal and prefer approach 1 continuously.  |
| Moderator Notes3 | Thanks for the comments. It appears that the suggested formulation for Approach 1 and Approach 2 is OK for the companies. Further discussion can focus on selecting from these approaches.  |
| MTK | Thanks for the good discussions. Hopefully we can have a down-selection in the upcoming GTW session. |

**Discussion Point 2v2-2**

* Companies are encouraged to provide their view on the following
	+ Option 1
		- monitoring of USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2 on P(S)Cell is not supported for Type A UE configured for sSCell to P(S)Cell scheduling
	+ Option 2
		- monitoring of USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2 on P(S)Cell is supported for Type A UE configured for sSCell to P(S)Cell scheduling
		- The WA from RAN1#104-e is updated (if needed) to reflect the above.

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

|  |  |
| --- | --- |
| **Company Name** | **Comments (Discussion Point 2v2-2)** |
| Moderator Notes2 | This related to last main bullet of Discussion point 2 for which only few companies provided a view. Modified and moved as separate discussion point for further discussion.  |
| LG Electronics | We prefer Option 2. |
| Apple | We are confused by this proposal. The WA we made in RAN1#104-e is to support DCI formats 0\_1/1\_1/0\_2/1\_2 monitoring on PCell/PSCell, but UE can also indicate that UE does not support it. We do not think we need to revert or change the WA, in summary, * Monitoring of USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2 on P(S)Cell is supported for Type A UE in the specification
* It is UE optional feature
 |
| Nokia, NSB | The RAN1#104 WA reads as**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.

Option 2 doesn’t seem to add anything to the WA, and there doesn’t seem to be a pressing need to overturn the WA. Option 1 would overturn the WA, but the justification to do that seems to be missing. |
| Xiaomi | Option 2. We don’t see the reason to restrict the DCI formats transmitted on the scheduled PCell/PSCell. |
| ETRI | We support Option 2. We agree with Xiaomi. |
| ZTE | Our preference is Option 2.If the main concern from companies is simultaneous monitoring of USS on PCell and USS on sSCell, our understanding is that monitoring of USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2 on P(S)Cell can be supported as long as the USS is not overlapping with USS on sSCell for scheduling PCell.  |
| Samsung | Option 2. There is no reason to restrict USS configuration on the P(S)Cell especially since no overbooking is allowed on the sSCell.  |
| Qualcomm | We are OK with the FL proposal. Regarding the final decision on whether to introduce a specific optional capability for monitoring non-fallback DCI formats on PCell/PSCell, we would like to see the consequence on Proposal 2v2-1. If possible approach 2 with advanced BD/CCE handling is taken for Proposal 2v2-1, we would need some ways to relax the UE implementation. |
| Ericsson2 | We prefer Option2.  |
| Huawei, HiSi | We support Option 2. We agree with Xiaomi. |
| Intel | We prefer Option2. Our understanding is both approach 1 and approach 2 supports that DCI format 0\_1/0\_2/1\_1/1\_2 to be configured on P(S)Cell. Therefore, Option 2 is straightforward.  |

### roposal 2v3-2

* Monitoring of USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2 on P(S)Cell is supported for Type A UE (from RAN1#105-e agreement) configured for sSCell to P(S)Cell scheduling

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

|  |  |
| --- | --- |
| **Company Name** | **Comments (Proposal 2v3-2)** |
| Moderator Notes3 | Thanks for the comments to Discussion point 2v2-2 Since companies seems to be OK with Option 2 perhaps it can be confirmed as shown in Proposal 2v3-2.  |
| MTK | We are fine with the FL proposal. |

### 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 |
| OPPO | We are fine with the proposal. |
| NTT DOCOMO | We are fine with the proposal. |
| Ericsson1 | OK with the proposal |
| Moderator Notes2 | Proposal seems to be stable. |

### Proposal 4 (for working assumption)

* 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. |
| OPPO |  | Does this proposal provide a cross-check condition of RRC configuration for CIF or an overriding condition upon CIF where the CIF configuration for Pcell is overridden by something on sSCell side? Please clarify.  |
| NTT DOCOMO | Support |  |
| Ericsson1 | Support | This keeps the DCI size budgets for scheduling the P(S)Cell intact. Question to Huawei – since the discussion is on size of DCI formats for s-p and p-p, which other fields do you think would not be aligned? |
| Moderator Notes2 |  | Most companies (Apple, Qualcomm, Samsung, Intel, Xiaomi, vivo, ZTE, MTK, Nokia/NSB, ETRI, CMCC, NTT Docomo, Ericsson) support or are ok with the proposals.Some clarifications below* @Huawei, Nokia, LG – Without the proposal, UE has to monitor e.g. two sizes of DCI format 1\_1 for P(S)Cell scheduling. (s-p) DCI format 1\_1 with CIF field and (p-p) DCI format 1\_1 without CIF field. Other fields are expected to be same since they are based on PDSCH-config of P(S)Cell.
* @Oppo – CIF is only configured for sSCell (per previous agreement). There wouldn’t be a separate CIF configuration for P(S)Cell. If CIF of n bits with value X is configured for sSCell, then according to the proposal a CIF field of n bits is appended to non-fallback DCI formats of P(S)Cell.
 |
| LG Electronics |  | Thanks for the response.Follow-up question: What is the problem if UE has two different sizes of DCI format 1\_1? If it may cause DCI size budget problem, UE will follow the procedure defined in 212 specification. Can’t this procedure resolve this issue?Furthermore, Proposal 4 suggests non-fallback DCI formats on P(S)Cell include same number of CIF bits. Are those bits just padding bits or actual CIF value? For the latter case, is the value of CIF same as that on sScell?? |
| Vivo2 | Support | Regarding LG’s 1st question, for one scheduled cell, DCI 1\_1 only has one size in legacy R15 and R16. So the size alignment procedure doesn’t consider such situation at all. I don’t think it could solve the issue. Besides, having two size for DCI 1\_1 scheduling the same cell is really a waste of size budget.Regarding LG’s 2nd question, CIF in Pcell non-fallback DCI is not a new thing and it already exists in legacy R15 and R16 for SS sharing. If looking at the following IE, cif-Presense if configured to determine whether CIF is existing in non-fallback DCI. CIF value is 0 for self-scheduling.CrossCarrierSchedulingConfig ::= SEQUENCE {schedulingCellInfo CHOICE { own SEQUENCE { -- Cross carrier scheduling: scheduling cell cif-Presence BOOLEAN }, other SEQUENCE { -- Cross carrier scheduling: scheduled cell schedulingCellId ServCellIndex, cif-InSchedulingCell INTEGER (1..7) }} |
| Qualcomm2 | Support | Fully agree with Vivo2. |
| Ericsson2 | Support |  |
| Huawei, HiSi | FFS | We understand the CIF part but not sure about the other part that is being discussed. For example, will dormancy operation for sSCell lead to any difference depending on whether SCell-PCell scheduling is configured? |
| Intel | Support | We would like to clarify that which cell can send the trigging DCI for SCell dormancy switching. Our understanding is both P(S)Cell and sSCell (s-p scheduling) can transmit the triggering DCI. In fact, if DCI 0\_1/1\_1 is not configured on P(S)Cell, e.g. Type A UE, the triggering DCI must be on sSCell. On the hand, P(S)Cell can transmit triggering DCI if proper DCI 0\_1/1\_1 is configured by defaults. Maybe we can make a quick clarify on early agreement if other companies are fine.  |
| Moderator Notes3 |  | Thanks for further comments.Considering the comments, would making proposal 4 as WA be OK with everyone? It has been agreed in 104b-e that there will be CIF field for (s-p) and so alignment with (p-p) is needed. Regarding the SCell dormancy indication field, as commented by Intel, if the field is included in non-fallback DCIs for P(S)Cell scheduling i.e., both (s-p) and (p-p), size alignment is not needed but this can be left for further discussion.  |
| MTK | Support | We are fine with the FL proposal. |

**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 eparate 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. |
| OPPO | We are in principle OK with the proposal, with the assumption that this does not lead to any L1 spec impact. But a clarification in respect to QC’s question should be helpful.  |
| NTT DOCOMO | We are fine with the proposal. |
| Ericsson1 | Support the proposal |

**Proposal 5v2 (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* )
	+ FFS: case when sSCell is configured with *ca-SlotOffset*
* Note: No additional L1 spec impact related to *ca-SlotOffset* had been identified

|  |  |  |
| --- | --- | --- |
| **Company Name** | **Support/ Not Support** | **Comments (Proposal 5v2)** |
| Moderator Notes2 |  | Updates to Proposal 5 based on comments received so far.@Qualcomm, MTK – added a FFS point to reflect you comment@Nokia – I attempted a Note to reflect your comment. |
| MTK |  | We are fine with Proposal 5v2 |
| Apple | Some concern  | Currently, we have two UE capability related to non-aligned CA operation, i.e., interCA-NonAlignedFrame-r16, interCA-NonAlignedFrame-B-r16.Support of this two feature does not consider the additional complexity when we need to support two cells to schedule one cell simultaneously. Therefore, we are fine to support this in specification, but we need to make sure this is an additional UE capability. So we propose to addNote: This is UE optional feature (support of cross-carrier scheduling from SCell to P(S)Cell with unaligned CA) |
| Nokia, NSB | Small concern | Thank you for attempting to address my comment, and apologies for not providing a concrete text. I think this is fine as a conclusion, and if spec needs are identified, then we would not automatically work on the CRs that are required to integrate the two features, but would discuss first if the integration will take place at all, of it the combination is just not supported. |
| Xiaomi |  | OK |
| ZTE |  | We prefer the proposal without this FFS. The FFS seems to be conflicting with the Note there. The note says that we didn’t identify any L1 spec impact, if there is no impact, what do we need to FFS here? |
| Samsung |  | OK in principle with the proposal. In view of the added FFS, the main bullet needs clarification (i.e., to which SCell *ca-SlotOffset* is applied.) |
| Qualcomm |  | We share the view with Apple. Unaligned CA between cells scheduling different cells, and unaligned CA between cells scheduling the same cell, are different. We think a separate UE capability is necessary to support it. |
| Ericsson2 | Support |  |
| Intel | Support |  |

### Proposal 5v3 (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* ), and a non-zero value for *ca-SlotOffset* can be configured at least for SCells other than the sSCell
	+ FFS: Whether case when sSCell is configured with non-zero *ca-SlotOffset* is supported and any associated capability signalling
* Note: No additional L1 spec impact related to *ca-SlotOffset* had been identified

|  |  |  |
| --- | --- | --- |
| **Company Name** | **Support/ Not Support** | **Comments (Proposal 5v3)** |
| Moderator Notes3 |  | Thanks for the comments. Based on the comments, updated proposal 5v2 to 5v3 with below changes.Included “and a non-zero value for *ca-SlotOffset* can be configured at least for SCells other than the sSCell” in main bullet to address comment from Samsung. Modified the FFS to hopefully addresses comments from Apple and Qualcomm.@ZTE, at least in my view, the Note is OK as it mentions “additional spec impact”.  |
| MTK | Support | We are fine with the FL 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 aspects1. 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)Cellb.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. |
| OPPO | Several questions: 1. What does “The additional PDCCH monitoring candidates/DCI formats not monitored on P(S)Cell when sSCell is activated” actually refer to? It can include two types, which one or both are referred to?
* The non-fallback DCI in UE-specific SS that schedules P(S)Cell – this means P(S)Cell’s self-scheduling is fully recovered.
* The DCI that schedules other Scells – this means P(S)Cell’s cross-carrier scheduling capability is also recovered.
1. Whether the UE’s BD capability/limits framework should be adjusted accordingly (at least in case Pcell and sSCell have different SCS)?
2. Should Gnb and UE need to know a common moment when the above changes are finalized on UE side?
3. Whether the activation of sSCell puts everything back again? If yes, should/how Gnb and UE have the common understanding of when the old life is back?

For us, the proposal is an optimization, which can be replaced by re-configuration of CCS before deactivating sSCell.  |
| NTT DOCOMO | We support the proposal. It should be applied for both cases of deactivation and dormant. |
| Ericsson1 | Support the proposal |
| Moderator Notes 2 | Some clarifications below@Apple – Regarding the motivation – CCS from P(S)Cell to sSCell is configured to opportunistically use the sSCell. SSCell can be deactivated for a number of reasons including power savings, lack of coverage. When sSCell is deactivated, the resulting operation of P(S)Cell would be worse than current system due to BD/PDCCH monitoring constraints imposed on P(S)Cell related to sSCell USS monitoring. This issue will be worse for Type A Ues (even worse if non-fallback DCI format monitoring is not supported on P(S)Cell for such Ues). @Samsung – DCI or MAC/CE based “replacement of the sSCell ” as proposed requires multiple Scells configured as sSCell for the UE which is precluded by RAN1#102-e agreements.@Intel – the sub-bullets each capture a different alternative. Can label as Alt1:, Alt2: if it helps.@Oppo – on 1) “The DCI that schedules other Scells” is precluded by RAN1#102-e agreement (Pcell cannot be used for cross-carrier scheduling when sSCell is configured for the UE). On 2) BD limits are adjusted 3) follows activation deactivation timeline which is already specified 4) yes, based on activation of sSCell |
| Nokia, NSB | Thanks to Moderator for explaining the reasons why we would see the need to define a fall-back mechanism. We’d be open with any solution, but feel that this is a crucial piece for the feature to avoid RRC reconfiguration when sSCell is not available due to lack of coverage, or there is no traffic to justify the power consumption of two carriers. |
| Moderator Notes3 | No updates in this version. More discussion seems to be needed to converge.  |

**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 referableId 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 referabl to toggle the interpretation, i.e., which SS set should UE check for those referable 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 referable 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. |
| OPPO | Not support | We think it is better not to change the search space linking procedure. If the additional IE is defined in sSCell-scheduling-Pcell case, how about other general cross-carrier scheduling cases, such as Scell-scheduling-Scell? |
| NTT DOCOMO | Support | The case that different SCS are used between sSCell and P(S)Cell is important especially in the DSS scenario. |
| Ericsson1 |  | We are in principle OK, but if this is not agreed, perhaps better to explicitly conclude that Rel-16 SS set linking is also used for the parameters: monitoringSlotPeriodicityAndOffset, duration, monitoringSymbolsWithinSlot |

### Proposal 7v2 (for conclusion)

* When CCS from sSCell to P(S)Cell is configured for a UE
	+ monitoringSlotPeriodicityAndOffset, monitoringSymbolsWithinSlot, duration for the PDCCH monitoring candidates monitored on sSCell as determined per Rel16 SS linking approach

|  |  |  |
| --- | --- | --- |
| Moderator Notes2 | **Support/ Not support** | Is it OK to take above updated Proposal 7v2 as conclusion? |
| LG Electronics | Support |  |
| MTK | Support | We are OK considering that more than half companies do not support Proposal 7, although we support. |
| Apple | Support | We are fine to support the proposal.If we change the SS configuration for CCS, it is better to change it consistently, instead of only change it in the case of sSCell scheduling SpCell.  |
| Nokia, NSB |  | This is the inevitable outcome if nothing is agreed to improve the situation. Given the comments during the 1st round it seems impossible to agree to anything to improve the situation, we reluctantly accept this conclusion. |
| ETRI | Support |  |
| ZTE | Support | OK |
| Samsung |  | Since a full separation is not agreed, we prefer to keep the existing search space linking framework intact. The wording can be updated to include all search space parameters, to avoid further discussion on this issue in Rel-17. |
| Ericsson2 | Support |  |

‘

|  |  |  |
| --- | --- | --- |
| Huawei, HiSi | Y |  |
| Intel | Support |  |
| Moderator Notes3 |  | Thanks for the comments. The conclusion seems to be OK for most companies. Regarding Samsung suggestion to extend the conclusion, monitoringSlotPeriodicityAndOffset, monitoringSymbolsWithinSlot, duration were discussed for a couple of meetings and it would be good to capture the conclusion of that discussion. Regarding other parameters, perhaps it is better if companies can check a bit further and comment. |
| MTK | Support | We are fine with the FL proposal. |

# 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%3A%5CUsers%5CDocs%5CR1-2108576.zip) is endorsed in principle

Final LS [R1-2108662](file:///C%3A%5CUsers%5CDocs%5CR1-2108662.zip) is endorsed