3GPP TSG RAN WG1#108-e R1-22XXXXX

e-Meeting, February 21st – March 3rd, 2022

Source: Moderator (vivo)

Title: FL summary#1 of DCI-based power saving adaptation

Agenda Item: 8.7.2

Document for: Discussion and Decision

# Introduction

This contribution is a summary of the AI 8.7.2 for RAN1#107bis-E.

* Section 2 is a list of the issues to be discussed/decided.
* Section 3 is a list of proposals for further discussion .
* Section 4 is a summary of previous meeting agreements.
* Section 5 is a summary of proposals from companies’ contributions submitted.
* Section 6 is void.
* Section 7 is the decription of WI.
* Section 8 is the reference documents.
* Section 9 is the history of the FL summary.

# Issue list

## Issues#1: bit-width for case 2/3

### Initial proposals for RAN1#108

*BWP-DownlinkDedicated* -> *pdcch-Config* -> *searchSpacesToAddModListExt-v17xy*-> *SearchSpaceExt-r17*-> *searchSpaceGroupIdList-r17.*

And During the email discussion of TS38.212 and contributions received in this meeting, the following proposals are made,

*The companies in ‘black’ color is from the opnions in this meeting’s contribution. The companies in ‘red’ color does not provide comments in this meeting and thus copy the same opinions from previous meetings.*

|  |
| --- |
| For DCI format 0\_1, DCI format 0\_2, DCI format 1\_1 and DCI format 1\_2,     * 1 or 2 bits, if *PDCCHSkippingDurationList* is not configured and if *searchSpaceGroupIdList-r17* is configured

**Option 1: Support: Nordic, Qualcomm, Nokia, Samsung, ~~IDCC~~, CMCC**-     1 bit if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0 and search space set(s) with group index 1, and if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;-     2 bits if the UE is configured by searchSpaceGroupList-r17 with search space set(s) with group index 2.**Option 2: Support: Nordic, Qualcomm, Nokia, Samsung, Lenovo, MTK, ETRI, vivo**-     1 bit if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;-     2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 2;**Option 3: Support: ZTE, Ericsson, Huawei, Intel, OPPO, Panasonic, NEC**-     1 bit if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0 and search space set(s) with group index 1, and if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;-     2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0, search space set(s) with group index 1 and search space set(s) with group index 2;**Option 4: Support: Nordic, MTK, Nokia, ~~Panasonic~~, LGE, IDCC, vivo**- 1 bit if the UE is configured *numOfSSSG* = 2- 2 bits if the UE is configured *numOfSSSG* = 3- Note: *numOfSSSG* is per BWP configured |

#### [Medium] Proposal 1-1 (v1) - bit-width for case 2/3

* ***FL recommendations***

According to the situation described above, FL recommends to further down-select from option 2 and 3

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| For DCI format 0\_1, DCI format 0\_2, DCI format 1\_1 and DCI format 1\_2,     * 1 or 2 bits, if *PDCCHSkippingDurationList* is not configured and if *searchSpaceGroupIdList-r17* is configured

**Option 2:** -     1 bit if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;-     2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 2;**Option 3:** -     1 bit if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0 and search space set(s) with group index 1, and if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;-     2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0, search space set(s) with group index 1 and search space set(s) with group index 2; |

### Companies views (1st round)

|  |  |
| --- | --- |
| Company | Comments |
| CATT | Option 3 |
| Nordic | Option 2 for technical reasons mentioned in contribution |
| ZTE,Sanechips | Option 3 |
| Qualcomm | We support Option 2. |
| Nokia\_1 | Option 2 |
| LGE | Okay with majority but slightly prefer Option 2.  |
| MediaTek | Both Option 2 and Option 3 are fine for us. Since network can still configure an ‘empty SSSG’ by labelling a dummy SSS with zero PDCCH candidate number, Option 3 can provide the same outcome as Option 2. In the regard, we suggest to go with majority decision to close this issue. |
| Huawei,HiSilicon | Option 3 |
| Panasonic | Option 3 |
| NEC | Option 3 |
| intel | Option 3 |
| Moderator | If companies can clarify that the current specification allows configure a SS set with zero of BD number for each AL, the ‘empty’ SS SSSG has already been possible. In that sense, either option 2 or 3 is fine. We can follow majority or even option 3 is also possible with ‘empty’ SSSG.By this, can we agree with option 3?For DCI format 0\_1, DCI format 0\_2, DCI format 1\_1 and DCI format 1\_2,     * 1 or 2 bits, if *PDCCHSkippingDurationList* is not configured and if *searchSpaceGroupIdList-r17* is configured

**~~Option 2:~~** ~~-     1 bit if the UE is not configured by~~ *~~searchSpaceGroupIdList-r17~~* ~~with any search space set with group index 2;~~~~-     2 bits if the UE is configured by~~ *~~searchSpaceGroupIdList-r17~~* ~~with search space set(s) with group index 2;~~**~~Option 3:~~** -     1 bit if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0 and search space set(s) with group index 1, and if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;-     2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0, search space set(s) with group index 1 and search space set(s) with group index 2; |
| IDCC | We are ok with both options but slightly prefer option 3. |
| Samsung  | We are OK with Option 3. |
| Lenovo | We are fine with Option 3.  |
| Nokia\_2 | With the clarification proposed by FL we could consider the proposal/option 3, but we would like first understand if this is a common understanding? |
| DOCOMO | We are fine with Option 3. |
| Ericsson1 | Support Option 3.  |
| Huawei, HiSilicon | We support the Option3. Regarding configuring a search space with PDCCH candidate, we are not sure on the benefit considering it wastes a search space by UE. Nevertheless, it is dummy search space which is different from “empty SSSG” to duplicate PDCCH skipping functionality. |

## Issues#2: skipping Type 0/0A/1/2 CSS

### Initial proposals for RAN1#108

**Support (12)**

* Xiaomi, Qualcomm, MTK, Huawei, Apple, Lenovo, Intel, LGE, IDCC, CMCC(majority), vivo(except BFD), ZTE

**No (6)**

* Nordic, ~~ZTE~~, Panasonic, Samsung, CATT, Nokia(If the power consumption cost between the options is insignificant, we would prefer to stick to the earlier agreement), OPPO

**Either is OK:**

* Ericsson
* ***FL recommendations:*** FL recommends to consider one of the following proposals

#### [Medium] proposal 2-1 (v1) – skipping C-RNTI/... in Type 0/0A/1/2 CSS

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| --- |
| **Proposed by Huawei**When the UE is indicated PDCCH skipping for a duration on a serving cell, the UE skips monitoring of PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in the one or more search space sets by corresponding one or more of *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *ra-SearchSpace*, in the duration on the serving cell.**Proposed by LGE**After receiving indication of PDCCH skipping, a UE should not monitor PDCCH candidates for a DCI with CRC scrambled by C-RNTI (and MCS-C-RNTI, CS-RNTI) in a Type0/0A/1/2-PDCCH CSS set for a skipping duration**Proposed by MTK, ZTE**UE skips monitoring of PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI in any CSS and USS when UE is indicated skipping PDCCH monitoring for a duration. |

### Companies views (1st round)

|  |  |
| --- | --- |
| Company | Comments |
| CATT | PDCCH skipping is for UE to skip all PDCCH monitoring within the indicated interval. We don’t see the need to single out the skipping of Type 0/1/1a/2/2a CSS for PDCCH skipping.  |
| Nordic | As said before, monitoring in Type 0/1/1a/2/2a in RRC connected is so seldom that power saving gain from this is insignificant. On the other hand, it simplifies implementation if Type 0/1/1a/2/2a monitoring is not impacted by skipping or SSG switching. |
| Apple | Prefer text proposals by MTK/ZTE |
| ZTE, Sanechips | UE skips monitoring of DCI scrambled by C-RNTI, MCS-C-RNTI, or the CS-RNTI is helpful to achieve more power saving gain. We support that when the UE is indicated skipping PDCCH monitoring for a duration on a serving cell, the UE skips monitoring of PDCCH candidates for DCI with CRC scrambled by the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in CSS any CSS and USS. |
| Qualcomm | In our view, a unified and complete way of describing PDCCH skipping behavior is listing all different types of PDCCHs that are impacted by the PDCCH skipping, regardless of the search space set in which the PDCCHs would be monitored. Thus, as we proposed in our contribution, we suggest the following description:During an indicated PDCCH skip duration, PDCCH monitoring activity for DCI formats with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, CI-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, TPC-SRS-RNTI, or AI-RNTI in any CSS and USS is impacted. |
| Nokia\_1 | As UE is anyway expected to monitor PDCCH for e.g. P-RNTI, monitoring also C-RNTI in the same search space does not seem to imply any notable power consumption increase. Therefore we don’t think it is necessary to omit monitoring in these occasions. These should be also in witche less frequent than CSI etc. monitoring that is done. |
| LGE | We are fine with the proposal by MTK, ZTE. We shared view with Qualcomm. It is needed to keep consistency throughout the specificifatoin.  |
| MediaTek | In our understanding, not monitoring C-series RNTI during skipping duration simplifies the UE behavior. To avoid potential retransmission(s) handling for unicast data scheduling, it is recommended UE skip all unicast RNTIs during the skipping duration.For the text proposal, we prefer the proposal by MTK/ZTE. |
| Huawei,HiSilicon | We are fine with either HW’s TP or MTK/ZTE’s TP. |
| Panasonic | For system stability, to keep UE monitoring type 0/0A/1/2 CSS is sensible for implementation of both gNB and UE. The power saving gain is still valid and not compromised in our view. |
| NEC | UE skips monitoring of PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI in any CSS and USS when UE is indicated skipping PDCCH monitoring for a duration. |
| Intel | We are fine with the intention behind all these TPs, however we need to keep in mind the following RAN2 agreement made in RAN2#116bis-e. 1. UE ignores PDCCH skipping while the SR is pending.
2. If PDCCH skipping is applied to RNTI(s) monitored during RAR/MsgB window, the UE ignores PDCCH skipping during the RAR/MsgB window.
3. UE ignores PDCCH skipping while contention resolution timer is running.

Hence, perhaps we can modify the MTK TP as follows. This may also address the RAN2 LS response issue # 7. Please also check response to issue # 7.UE skips monitoring of PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI in any CSS and USS when UE is indicated skipping PDCCH monitoring for a duration, except when SR is pending, *ra-ContentionResolutionTimer* or *raResponseWindow or msgBResponseWindow* is running [TS 38.213]. |
| Moderator | Considering this situation, let’s consider MTK/ZTE’s TP as start point with the following comments,1. Considering the proposal also covers USS and type 3CSS, so adding a note: ‘This replaces the previous agreement in RAN1#106-E: PDCCH based monitoring adaptation is applied to USS and type-3 CSS’
2. Considering the RAN2 LS, the agreement should not impact any PDCCH moniroting related to RAR/MsgB/Msg4 reception during RAR window/MsgB window/contention resolution timer. Further discussion may be needed on how to capture it according to RAN2 LS.

**Proposed by MTK, ZTE – modified** * UE skips monitoring of PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI in any CSS and USS when UE is indicated skipping PDCCH monitoring for a duration, except.
	+ - [PDCCH skipping is not applied to PDCCH monitoring for RAR reception during RAR window]
		- [PDCCH skipping is not applied to PDCCH monitoring for MsgB reception during MsgB window]
		- [PDCCH skipping is not applied to PDCCH monitoring for Msg 4 reception during contention resolution timer]
* It is up to spec editor how to capture the above in RAN1 specification
* Note: This replaces the previous agreement in RAN1#106-E: PDCCH based monitoring adaptation is applied to USS and type-3 CSS.
 |
| IDCC | We are fine with MTK/ZTE proposal. |
| Samsung  | We are not convinced by additional power saving gain to allow PDCCH skipping in any of Type 0/1/1a/2/2a CSS set. Given RAN2 agreements, it’s clear that Type1-PDCCH-CSS set and C-RNTI for RAR/MsgB/Msg4 can not be impacted. We don’t think it’s a good way to further extend applicable area for PDCCH skipping.  |
| DOCOMO | We are fine with MTK/ZTE proposal. |
| Ericsson1 | Regarding the moderator intermediate proposal, * OK with the first bullet, and with the intention to add cases based on RAN2 LS. For the subbullets, prefer to simply say “*PDCCH skipping is not applied to PDCCH monitoring during RAR window/MsgB window/contention resolution timer”*.
* We don’t agree with the note – in our understanding, the intention of current proposal is 1) to add more cases where skipping is applied on top of skipping applied to USS/Type-3 CSS, and 2) exceptions as per RAN2 LS.
 |
| Xiaomi | fine with MTK/ZTE proposal.And after review other companies views, we also admit that additional power saving gain to allow PDCCH skipping in any of Type 0/1/1a/2/2a CSS set is limited. We can go either way. |
| Huawei, HiSilicon | We support the proposal from MTK/ZTE. Some response to Samsung’s comments, regarding RAN2’s agreement, they are not exclusive with the proposal. We agree with moderator that RAN2’s agreement is discussing exceptional cases where PDCCH skipping is canceled. For the power saving, the power saving benefit on UE side would be impacted a lot if UE needs to always wake-up to monitor Type 0/1/1a/2/2a CSS set, which reduces the chances where the UE could switch off the RF chains. You can find more analysis in our contributions. |
| Qualcomm\_2 | As we commented above, the revised proposal suggested by Moderator does not seem to be a complete description of PDCCH skipping. For the new bullets added by Moderator,* RAR (MsgB) reception in RAR (MsgB) window is not affected by PDCCH skipping, as discussed in Issue#7. BFR response reception in RAR window is a different story, though.
* Likewise, for CBRA, Msg4 reception is through Type1 CSS, so it is not affected by PDCCH skipping.

In our view, without needing to add bullet points as above, we can categorize all RNTIs into two groups, depending on whether they are affected by PDCCH skipping or not. For example, C-RNTI, MCS-C-RNTI, CS-RNTI, CI-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, TPC-SRS-RNTI, or AI-RNTI will be affected by PDCCH skipping. On the other hand SI-RNTI, RA-RNTI, MsgB-RNTI, P-RNTI, PS-RNTI, by G-RNTI, or G-CS-RNTI, or MCCH-RNTI will not be affected by PDCCH skipping.This approach has a benefit, rather than just saying “PDCCH monitoring in Type3 CSS and USS is affected by PDCCH skipping”. As pointed out in Section 2.7.1.6, there are some exceptional RNTIs in Type3 CSS that should not be affected by PDCCH skipping, such as G-RNTI, G-CS-RNTI, or MCCH-RNTI. Also, as discussed in Issue#7, if Approach3 is taken, PS-RNTI monitoring in Type3 CSS should be another exception of PDCCH skipping. As such, instead of adding those exception cases of Type3 CSS, we can simply state which RNTIs are affected and which are not. |

## Issues#3: SSSG switching timer

### Initial proposals for RAN1#108

*The companies in ‘black’ color is from the opnions in this meeting’s contribution. The companies in ‘blue’ color does not provide comments in this meeting and thus copy the same opinions from previous meetings.*

If a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE

**-       resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot**

* Alt 2a: for the Type3-PDCCH CSS set or the USS set with group index of either 1 or 2

Support: ~~Huawei~~, Samsung, Lenovo, CMCC, Xiaomi, CATT

* Alt 2a-modified: with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI in a PDCCH reception in the slot for the Type3-PDCCH CSS set or the USS set with group index of either 1 or 2

 Support: Huawei

* Alt 2b: for the Type3-PDCCH CSS set or the USS set

Support: OPPO, Intel, Panasonic(2nd preference), ~~Apple~~, Nordic, ZTE, Nokia, IDC, Nordic

* Alt 2c: with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI

Support: Qualcomm, Nokia, Panasonic, Ericsson, MTK, ~~Apple~~, ETRI, IDC, vivo, Nordic

* Alt 2d: DCI format 0-1, 0-2, 1-1 and 1-2 and the value for PDCCH adaptation bit value is set to ‘01’, ‘10’, ‘11’

Support: Apple

**-       otherwise,**

* Alt 3a:decrease the timer value by one after each slot.

Support: Huawei, ZTE, vivo, CATT, MTK, Nordic, Xiaomi, Qualcomm, Nokia, ~~Apple~~, Ericsson, Samsung, Intel, LGE, CMCC, ETRI, IDC

* Alt 3a-modified:
	+ For PDCCH monitoring adaptation case 4, decrease the timer value by one after each slot if UE does not apply PDCCH skipping
	+ For PDCCH monitoring adaptation case 2 and 3, decrease the timer value by one after each slot.

Support: Apple, MTK

* Alt 3c:decrements the timer after a slot of an active DL BWP of the serving cell when the UE does not detect a DCI format in a PDCCH reception in the slot for Type3-PDCCH CSS set or the USS set with group index of either 1 or 2

Support: Samsung, Panasonic, Lenovo

**When the timer expires in a slot,**

* Alt 1a: the UE starts to monitor PDCCH on the serving cell according to search space sets with group index 0 at the beginning of the first slot that is at least [an application delay of timer based SSSG switching]after the slot where timer expires, irrespective the UE has been indicated skipping PDCCH monitoring for a duration or not

Support: CATT, vivo, CMCC, ~~Qualcomm~~, ~~Ericsson~~, Apple(if Alt 3a-modified is agreed), Intel

* Alt 1b:
	+ For PDCCH monitoring case 2 and 3, adopt Alt 1a
	+ For PDCCH monitoring case 4
		- if the UE has not been indicated skipping PDCCH monitoring for a duration, adopt Alt 1a
		- otherwise, the UE starts to monitor PDCCH until the completion of the PDCCH skipping for the duration on the serving cell according to search space sets with group index 0.

Support: Huawei, Samsung, Lenovo, MTK, Xiaomi, Panasonic, ~~Intel(‘until’ modified as ‘after’),~~ LGE, Ericsson, ETRI, IDC, Qualcomm, ZTE

* ***FL recommendations***
	+ Majority companies support ‘reset timer’ is NOT restricted to PDCCH with group index of either 1 or 2. FL recommends companies to further consider Alt 2b and 2c.
	+ Most companies are OK with Alt 3a for decreasing the timer. While MTK pointed out that for the hybrid case, the problem can be resolved undamentally by not to decrease the SSSG timer during PDCCH skipping duration. UE will not perform SSSG switching during the PDCCH skipping duration. Alt3a-modified is suggested by MTK
	+ Slightly majority prefers Alt 1b. Further discussion is needed.

#### [High] proposal 3-1 (v1) – SSSG timer

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| If a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE-     resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI -      otherwise, decrease the timer value by one after each slot.When the timer expires in a slot, -     For PDCCH monitoring case 2 and 3, adopt Alt 1a-     For PDCCH monitoring case 4 * + - if the UE has not been indicated skipping PDCCH monitoring for a duration, adopt Alt 1a
		- otherwise, the UE starts to monitor PDCCH until the completion of the PDCCH skipping for the duration on the serving cell according to search space sets with group index 0.

-     Note: Alt 1a: the UE starts to monitor PDCCH on the serving cell according to search space sets with group index 0 at the beginning of the first slot that is at least [an application delay of timer based SSSG switching]after the slot where timer expires |

### Companies views (1st round)

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| --- | --- |
| Company | Comments |
| CATT | If UE is monitoring PDCCH on SSSG#0, why does UE needs to trigger the SSSG switching timer to witch back to SSSG#0 when timer expires. Thus, the SSSG switching timer is running only when UE monitoring PDCCH on SSSG#1 or SSSG#2. We don’t agree with the proposal.  |
| Nordic  | We are fine withIf a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE-     resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI -      otherwise, decrease the timer value by one after each slot.For the rest we propose the followingProposal-Nordic:UE expects that maximum configured PDCCH skipping duration value is shorter than configured SSSG inactivity timer value. |
| Apple | Timer is not applied to default SSSG. So timer reset only after receiving indication of ’01, 10, 11’. This aligns with current specification where timer is reset after ‘1’ is received in NR-U. The current proposal indicate timer will be used for default SSSG.  |
| ZTE, Sanechips | Similar with CATT, the SSSG switching timer should be running only when UE monitoring PDCCH on SSSG#1 or SSSG#2. However, there is no discussion about when/how to trigger the running of the timer. We proposed that the *searchSpaceSwitchTimer-r17* can be **started** when UE receives DCI indicating SSSG #1 or SSSG #2.For the issue of when to **reset** the timer while the timer is running, our preference is alt 2b. However, if majority companies support alt 2c, we can compromise to ‘resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI in Type 3 PDCCH CSS set or USS set’, which is alt 2b + alt 2c. |
| Nokia\_1 | On the first part of the **proposal 3-1** on timer reset behaviour, we agree with the proposal (like explained it would allow NW to keep the UE in the active SSSG also with fall-back DCI). In my understanding there is no timer associated to SSSG#0, so there should not be any ‘timer running’, thus the behaviour does not apply when UE is in SSSG#0. For timer expiry, when only SSSG switching is configured, Alt1a would seem appropriate. On the interaction with skipping, i.e. when both are configured, evidently UE should change to SSSG#0 when the SSSG switching timer expires (similar as in Alt1a). Then the discussion could be focused on whether UE continues to do skipping till duration expires or whether UE starts to monitor PDCCH immediately (based on SSSG#0).Also what has not been discussed, is what is the behaviour for expiry of skipping duration when SSSG switching has been configured. I.e. which SSSG to monitor. |
| MediaTek | Since the SSSG timer is used for switching to default SSSG automatically, whether to reset the timer when UE is indicated to switch to default SSSG does not impact the UE behavior. In the aspect of hybrid case, we can leave with majority. |
| Huawei, HiSilicon | 1. The decision may also have impact on the application delay of SSSG switching. If Alt.2c is adopted, it is basically means the timer shall always restart even though the current SSSG is not aligned between gNB and UE. In this case, SSSG swiching can only take effect after the HARQ-ACK transmission. Otherwise, the solution may not work roburstly.
2. The formulating of the Alt.1b seems strange and should make the proposal clear not describe the proposal by citing to Alt.1a. Also, the Alt.1b should be “after” instead of “until”, which should be a typo, and acceptable to companies. This may be also related with application delay of timer based SSSG switching. A joint TP may be needed when we have progress. An example is provided as following
 |
| Panasonic | We are okay with the proposals. |
| NEC | UE skips monitoring of PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI in any CSS and USS when UE is indicated skipping PDCCH monitoring for a duration. |
| Intel | Support, with following updates………the UE starts to monitor PDCCH ~~until~~  after the completion of the PDCCH skipping for the duration on the serving cell according to search space sets with group index 0. |
| Moderator1 | 1. My understanding is that according to the agreement in RAN1#106-E,
	* + UE fallbacks to default SSSG (i.e., SSSG#0) after timer expiration.

Only non-default SSSG can have a timer running. There is no agreement that timer is running for UE in SSSG#0. To address Apple and CATT’s comment, we can add a note to capture this.(2) ZTE proposes compromise proposal Alt 2b+2c so that companies may have a chance to check it.(3) Address Huawei’c comment, modified ‘until’ by ‘after’. Citing Alt 1a is just for convenience and we can revise it in the final version.(4) For Karol’s suggest, ‘UE expects that maximum configured PDCCH skipping duration value is shorter than configured SSSG inactivity timer value’, let’s see more companies’ opinions. And if we can agree on this, then the timer expiry UE behaviour will be simple to Alt 1a.Revised as follows,[High] proposal 3-1 (v2)- SSSG timerIf a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE-     resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI in Type 3 PDCCH CSS set or USS set.-      otherwise, decrease the timer value by one after each slot.Note: There is no timer for SSSG switching is running for UE in SSSG#0    When the timer expires in a slot, -     For PDCCH monitoring case 2 and 3, adopt Alt 1a-     For PDCCH monitoring case 4 * + - if the UE has not been indicated skipping PDCCH monitoring for a duration, adopt Alt 1a
		- otherwise, the UE starts to monitor PDCCH ~~until~~after the completion of the PDCCH skipping for the duration on the serving cell according to search space sets with group index 0.

-     Note: Alt 1a: the UE starts to monitor PDCCH on the serving cell according to search space sets with group index 0 at the beginning of the first slot that is at least [an application delay of timer based SSSG switching]after the slot where timer expires |
| IDCC | We are firne with the revised proposal. |
| Samsung | We support Alt2a, to match UE behavior to switch from SSSG#1/#2 to SSSG#0 when the timer expires. We are fine to compromise to Altb for the sake of progress. However, we don’t see need to add “with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI”. It should be consistent with the applicable range of SSSG switching, so we think Type 3 PDCCH CSS set or USS set is sufficient.  |
| Lenovo | Fine with the revised proposal. |
| Nokia\_2 | As Type3-PDCCH CSS can contain also GC-PDCCHs, we think that the restriction to C-RNTI/CS-RNTI/MCS-C-RNTI should be kept.  |
| LGE | We are fine with the revised proposal. |
| Ericsson1 | Regarding 1st change (adding “in Type 3 PDCCH CSS set or USS set.”), we are not OK, and support previous formulation. It also avoids ambiguity in cases where the search spaces may overlap.OK with the note about timer.3rd change – this may be OK as a conclusion, but potential confusion with respect to “PDCCH skipping being not applied “ should be taken into consideration.  |
| Xiaomi | Ok with the proposal |
| Huawei, HiSilicon | Although we prefer atl.2a, we are fine with the revised proposal if the majority view is to adopt Alt.2b. However, our view is that if we adopt Alt.2b+2c here, the application delay of SSSG switching needs to consider the DCI missing cases, i.e. SSSG switching should take effect after HARQ-ACK transmission/reception. The reason is the timer shall restart anyway by DCI scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI in any type3-CSS or USS, even if the monitored SSSG is not aligned between gNB and UE.(this can happen when a Type3-CSS/USS is not associated with any SSSG). Based on these reasons, we would like to have a joint decision for the timer and application delay of SSSG switching. |

## Issues#4: 480kHz and 960kHz

### Initial proposals for RAN1#108

* ***FL recommendations:*** Nokia, CATT, Panasonic, DOCOMO, Xiaomi suggest to confirm the following WA

#### [Medium] Proposal 4-1 (v1)- 480kHz and 960kHz

|  |
| --- |
| Confirm the following Working AssumptionThe 480kHz and 960kHz SCS is supported for Rel-17 PDCCH monitoring adaptation.* + The bit length is of the candidate skipping values and SSSG switching initial timer values in slots assumed to be the same as that for 120KHz SCS
 |

#### [Medium] Proposal 4-2 (v1)- 480kHz and 960kHz

Nokia, CATT, Xiaomi, DOCOMO and ZTE provide the values for 480kHz and 960kHz SCS. Huawei thinks it is up to B52.6 session to decide the detailed values of PDCCH skipping duration and SSSG timer for 480kHz and 960kHz SCS.

|  |
| --- |
| **Range of** SSSG switching initial timer values and PDCCH **skipping duration values for 480kHz and 960kHz are defined as follows:**Alt 1: (Proposal from CATT R1-2201372, DOCOMO R1-2201486, Xiaomi R1-2201919)* + - {4,8,12,16,…,640,1280,1600,2560,3200} for 480kHz SCS,
		- {8,16,24,32,…, 1280,1600,2560,3200,6400} for 960kHz SCS.

Alt 2: (Proposal from Nokia R1-2202330)* + - {2,3,4,8,12,16,…636,640,720,…,1200,1280, 1440, 1600, 1760,…,3040,3200} for 480kHz SCS
		- {2,4,7,8,16,24,…1280,1440,1600,2400,2560,2880,3200,…,6080,6400 } for 960kHz SCS

Alt 3: (Proposal from ZTE R1-2201133)* + - [{20,24,28,32,…,656, 960, 1280,1600,1920,2560,3200} for 480kHz SCS,](#_Toc6505)
		- [{30,38,46,54,…, 1302,1920,2560,3200,3840,5120,6400} for 960kHz SCS.](#_Toc11281)
 |

Note: total entries for 120kHz is 166 (bit-width is 8 bit).

The proposed values for 480kHz and 960kHz in R1-2201372 (CATT), R1-2201486(DOCOMO), R1-2201919(Xiaomi) are as follows,

* For 480kHz SCS
	+ 4,8,12,16,…,640 (step size 4 and total entries are 160)
	+ 1280,1600,2560,3200 ( total entries are 4)
	+ Total entries are 164
* For 960kHz SCS
	+ 8,16,24,32,…, 1280 (step size 8 and total entries are 160)
	+ 1600,2560,3200,6400 ( total entries are 4)
	+ Total entries are 164

The proposed values for 480kHz and 960kHz in R1-2202330 (Nokia) are as follows,

* For 480kHz SCS
	+ 2,3,4 (step size 1 and total entries are 3)
	+ 8,12,... 640 (step size 4 and total entries are 159)
	+ 720, 800, ... 1200, 1280 (step size 80 and total entries are 8)
	+ 1440, 1600, ... 3040, 3200 (step size 160 and total entries are 12)
	+ Total entries are 3+159+8+12 = 182
* For 960kHz SCS
	+ 2,4,7 (total entries are 3)
	+ 8,16,... 1280 (step size 8 and total entries are 160)
	+ 1440, 1600, ... 2400, 2560 (step size 160 and total entries are 8)
	+ 2880, 3200 ... 6080, 6400 (step size 320 and total entries are 12)
	+ Total entries are 3+159+8+12 = 183

The proposed values for 480kHz and 960kHz in R1-2201133 (ZTE) are as follows,

* For 480kHz SCS
	+ 24,28,32,…,656 (step size 4 and total entries are 159)
	+ 960, 1280,1600,1920,2560,3200 ( total entries are 6)
	+ Total entries are 159+6 = 165
* For 960kHz SCS
	+ 30,38,46,54,…, 1302 (step size 8 and total entries are 160)
	+ 1920,2560,3200,3840,5120,6400 ( total entries are 6)
	+ Total entries are 160+6 = 166

**DOCOMO**

Regarding whether it is applicable to non-LBT case only or both cases of LBT/non-LBT, we propose to leave it to B52.6G session.

### Companies views (1st round)

|  |  |
| --- | --- |
| Company | Comments |
| CATT | The UE blind decoding capability for SCS 480 and 960 kHz is based on a group of 4 and 8 slots respectively. This implies that UE would decode PDCCH as a group instead of slots. The skipping duration should be based on the group size as the step function. The step function is 4 and 8 slots for 480 and 960 kHz SCS respectively.  |
| Nordic | OK with 4-1, for 4-2 we do not have strong preference. |
| Apple | OK with 4-1. For 4-2, 4x or 8x scaling is reasonable.  |
| ZTE, Sanechips | OK with 4-1.For 4-2, the candidate SSSG timer value should be longer than the application delay of SSSG switching as discussed in our contribution, otherwise, UE may fall back to SSSG#0Before the end of application delay.Considering the Pswitch values in WA for SCS 480KHz and 960KHz, Alt 3 is preferred.Besides, the value range proposed by us has been updated in the summary session. |
| Qualcomm | We support Proposal 4-1. For Proposal 4-2, since the skipping duration granularity is related to the slot group size Xs slots, where $Xs\in \left\{\left[2\right],4\right\}$ for 480 kHz SCS and $Xs\in \left\{4,8\right\}$ for 960 kHz SCS, simply scaling the values of 120 kHz by factor of 2 or 4 would not be sufficient. As such, Alt 2 seems to be a good starting point and we can discuss adding additional values to supplement the granularity. |
| Nokia\_1 | We are fine to confirm the working assumption. For the durations, it is not clear why the skipping duration should be lower bound by the slot grouping? |
| LGE | Fine with proposal 4-1.For proposal 4-2, we prefer that it is up to B52.6 session.. |
| MediaTek | Fine with 4-1. But we suggest to leave the decision to 60 GHz agenda. |
| Huawei, HiSilicon | We are fine with Proposal 4-1 (v1).We prefer to ask B52.6 session to discuss this, considering as CATT commented they considers group of 4 or 8 slots blind detection capability. |
| Panasonic | We are okay with 4-1 and 4-2 Alt1.  |
| NEC | We are fine with 4-1 and 4-2 Alt1. |
| Intel | OK with P 4-1. For P 4-2, we do not have strong preference and OK to go with majority |
| Moderator1 | The Vice Chair witched the followings, so that we can discuss proposal 4-1/4-2 in other session.Dear Xiaodong and All, It was pointed out offline (thanks to Naoya from Docomo) that both [108-e-NR-52-71GHz-02] and [108-e-R17-PowSav-03] are discussing the same set of proposals on the supported values for searchSpaceSwitchTimer-r17 and PDCCHSkippingDuration for 480 kHz and 960 kHz. In order to avoid overlapping discussions and inconsistent decisions, it is proposed as following, exactly same as what has been announced by David in [108-e-NR-52-71GHz-02]:   Consolidate the email discussion for searchSpaceSwitchTimer-r17 and PDCCHSkippingDuration under [108-e-NR-52-71GHz-02].  If there is a need to have GTW discussion for this topic, we will have it in the 60 GHz GTW session. In this case, the joint session will be announced in advance and we will find a time slot that does not overlap with UE power savings.  With regards the related working assumption in the UE power savings session, it is to be confirmed in 8.7. The discussion in the 60GHz agenda for this issue will continue after the WA is confirmed. Thanks a lot for noting this information. |

## Issues#5: Application delay (including potential interaction with retransmission)

### Initial proposals for RAN1#108

The following application delay is proposals are observed,

**For PDCCH skipping,**

* Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating PDCCH skipping (i.e., Beh 1A), select one of the following schemes

*(Moderator’s Notes: the following Alt 1a and 1b has no interaction with retransmission, 9 companies support)*

* + **Alt 1a:** **(8, CATT, MTK, Nordic, Panasonic, ~~Qualcomm~~, vivo, ZTE, Nordic, Spreadtrum)**
		- the UE applies Beh 1A on the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.
	+ **Alt 1b: (4, Panasonic, Samsung, Spreadtrum, ZTE(*max (applicable K0min, Z)*))**
		- the UE applies Beh 1A on the serving cell is applied in the next Zµ slot, where Definition of Zµ is described in Table 5.3.1-1 in TS38.214

*(Moderator’s Notes: the following Alt 1c has interaction with retransmission and can be applied after HARQ-ACK/PUSCH transmission, 5 companies support)*

* + **Alt 1c:**  **(5, ETRI, IDC, vivo, Apple, LGE)**
		- For PDCCH skipping indication via 1-1/1-2, the UE applies Beh 1A next slot after the last OFDM symbol of ACK transmission, otherwise the indication is not applied.
		- for PDCCH skipping indication via 0-1/0-2, the UE applies Beh 1A next slot after the last OFDM symbol of PUSCH transmission

*(Moderator’s Notes: the following Alt 1c and 1d has interaction with retransmission and can be applied before HARQ-ACK transmission, 9 companies support)*

* + **Alt 1d: (7, CMCC(1a), Huawei/HiSi(1b, *max (applicable K0min, Z)*), Intel, Lenovo(1b), Nokia/NSB(1a), Samsung, Qualcomm)**
		- Alt 1a or Alt 1b, and the UE starts to perform PDCCH monitoring (i.e., Beh 1) when *drx-RetransmissionTimerDL/UL* is running during PDCCH skipping duration.
	+ **Alt 1e:  (1, Ericsson(1a))**
		- Alt 1a or Alt 1b, and
		- for PDCCH skipping indication via 1-1/1-2, If the UE fails to decode the associated PDSCH and/or transmit a NACK, UE start to perform Beh 1 (i.e., the PDCCH skipping is stopped) at the first slot after the last OFDM symbol of the NACK transmission
		- for PDCCH skipping indication via 0-1/0-2[/1-1/1-2], the UE applies Beh 1A on the serving cell after an RRC configured delay for UL [DL].
	+ **Alt 1f: (1, OPPO)**
		- Introduce a delay window in the PDCCH skipping indication, which is based on PDCCH-PDSCH-HARQ-ACK timing and re-scheduling timing.
		- In the delay window for retransmission, PDCCH monitoring can be only after PDCCH-PDSCH-HARQ-ACK timing and in few consecutive monitoring occasions.

**For SSSG switching,**

* Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating SSSG switching (i.e., Beh 2/2A/2B),  select one of the following schemes

*(Moderator’s Notes: the following Alt 2a and 2b has no interaction with retransmission, 13 companies support)*

* + **Alt 2a: (12, CATT, CMCC, Ericsson, Intel, Lenovo, MTK, Nordic, Panasonic, Qualcomm, vivo, ZTE, Spreadtrum)**
		- the UE applies SSSG switching on the serving cell at a first slot that is at least *Pswitch* symbols after the last symbol of the PDCCH
	+ **Alt 2b: (6, Lenovo, Panasonic, Samsung, Spreadtrum, vivo, ZTE(*max (applicable K0min, Z)*))**
		- the UE applies SSSG switching on the serving cell is applied in the next Zµ slot, where Definition of Zµ is described in Table 5.3.1-1 in TS38.214

*(Moderator’s Notes: the following Alt 2c has interaction with retransmission, , 5 companies support)*

* + **Alt 2c: (5, Ericsson, Huawei/HiSi, IDC, Apple, LGE)**
		- for SSSG switching indication via 1-1/1-2, the UE applies the indication [TBD: application delay] ~~1 slot~~ after the last OFDM symbol of ACK transmission, otherwise the indication is not applied. (**Ericsson, Huawei/HiSi, IDC, Apple**)
		- for SSSG switching indication via 0-1/0-2, the UE applies Beh 2/2A/2B next slot after the last OFDM symbol of PUSCH transmission (**Huawei/HiSi, IDC**)

*(Moderator’s Notes: the following behaviours can be discussed in proposal 3-1 )*

* Upon SSSG timer exipry, UE performs Beh 2 at a first slot that is at least *Pswitch* symbols after a slot where the timer expires  **(CATT, Huawei/HiSi, Intel, Qualcomm)**
	+ FFS value of *Pswitch,* e.g., Table 10.4-1 in TS38.213 for search-space group switching

#### [High] Proposal 5-1 (v1) – application delay

* ***FL recommendations:*** considering the late stage of the WI, we need to make some hard binary decision,
* For SSSG switching, majority companies prefer has no interaction with retransmission, among alt 2a and 2b, 2a is more preferred.
* For PDCCH skipping, although more companies (9) prefer has no interaction with retransmission, but still a lot of companies prefer has interaction with retransmission and can be applied after HARQ-ACK/PUSCH transmission(5) and has interaction with retransmission and can be applied before HARQ-ACK/PUSCH transmission (8).

FL proposes the following way forward,

* For SSSG switching, agree on Alt 2a
* For PDCCH skipping, it is not clear whether interaction with retransmission or not has clearly majority. FL suggests further consider Alt 1a/1b which has no interaction with retransmission and Alt 1c/1d which has interaction with retransmission. Further discuss is needed to make consensus on whether interaction with retransmission is supported.
* UE behaviour upon SSSG timer exipry can be discussed in proposal 3-1.

|  |
| --- |
| * Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating PDCCH skipping (i.e., Beh 1A), select one of the following schemes
	+ **Alt 1a:**
		- the UE applies Beh 1A on the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.
	+ **Alt 1b:**
		- the UE applies Beh 1A on the serving cell is applied in the next Zµ slot, where Definition of Zµ is described in Table 5.3.1-1 in TS38.214
	+ **Alt 1c:**
		- For PDCCH skipping indication via 1-1/1-2, the UE applies Beh 1A next slot after the last OFDM symbol of ACK transmission, otherwise the indication is not applied.
		- for PDCCH skipping indication via 0-1/0-2, the UE applies Beh 1A next slot after the last OFDM symbol of PUSCH transmission
	+ **Alt 1d:**
		- Alt 1a or Alt 1b, and the UE starts to perform PDCCH monitoring (i.e., Beh 1) when *drx-RetransmissionTimerDL/UL* is running during PDCCH skipping duration.
* Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating SSSG switching (i.e., Beh 2/2A/2B),
	+ **Alt 2a:**
		- the UE applies SSSG switching on the serving cell at a first slot that is at least *Pswitch* symbols after the last symbol of the PDCCH
 |

### Companies views (1st round)

|  |  |
| --- | --- |
| Company | Comments |
| CATT | Alt 1a & Alt 2a. PDCCH skipping is independent of PDSCH operation in cross-slot scheduling and HARQ operation. All power saving gains of PDCCH skipping had been shown without interaction of PDSCH operation in cross-slot scheduling and HARQ operation. The additional application delay consideration for cross-slot scheduling and HARQ operation would degrade UE power saving gain and complexity in specification.  |
| Nordic | Alt 1a & Alt 2aAlt 1a includes 1b, because for a UE with larger minimum scheduling offset, gNB may provide larger value of skipping. |
| Apple | Prefer to have HARQ re-transmission handled at least for PDCCH skipping cases. Otherwise, likely only very small skipping step will be configured. All the power saving evaluation shows larger skipping step will have bigger UE power saving gain.  |
| ZTE, Sanechips | For DCI based PDCCH monitoring adaptation, the decoding time of a DCI should be considered. Therefore, we prefer the following,**Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating PDCCH skipping (i.e., Beh 1A),** * **UE applies PDCCH skipping on an active BWP of the serving cell at the first slot after the application delay of minimum applicable scheduling offset if a minimum applicable scheduling offset is configured in the BWP,**
* **otherwise, UE applies PDCCH skipping on the BWP of the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.**

**Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating SSSG switching (i.e., Beh 2/2A/2B),*** **UE applies SSSG switching on an active BWP of the serving cell at the first slot after the application delay of minimum applicable scheduling offset if a minimum applicable scheduling offset is configured in the BWP,**
* **otherwise, UE applies SSSG switching on the BWP of the serving cell at the first slot that is at least Pswitch symbol after the last OFDM symbol of the PDCCH transmission.**

Besides, for the interaction with HARQ re-tx, the *drx-RetransmissionTimerDL/UL* is configured per MAC entity, the value may not proper for the dynamic indicated PDCCH skipping value. |
| Qualcomm | In fact, in our contribution, our intention was to support Alt 1a and additional HARQ handling by retransmission timers. In the proposal above, since the discussion on application delay and HARQ retransmission handling are not separated, we actually support Alt 1d. We are fine with Alt 2a. |
| Nokia\_1 | We would prefer proper handling of HARQ/re-TX for skipping due to the possible long latency. Like noted, if the UL scheduling DCI triggers the skipping, the last PUSCH may contain BSR for higher priority logical channel, thus omitting PDCCH monitoring for re-TX may effect negatively to the service quality. Thus we would prefer Alt1d (+1a). I.e. UE should not apply skipping during *drx-RetransmissionTimerDL/UL*. We are OK with Alt 2a. |
| LGE | We are still interest in Alt 2c regarding SSSG switching because it is simple and no further specification work is needed. Also it is useful to solve SSSG misalignment problem. But we can follow the moajority.Regarding PDCCH skipping, we shared view with Apple. Also, considering that skipping duration can be configured up to 100ms, HARQ retransmission should be handled. Otherwise, it may result in latency issues. |
| MediaTek | Support Alt 1a and Alt 2a.We agree that retransmission is a critical issue. And a similar mechanism for both PDCCH skipping and SSSG switching should be targeted. However, so far both Alts only aim at PDCCH skipping part. On the other hand, Alt 1d will induce complicated monitoring behavior, including whether/how to response PDCCH skipping indicator during drx-RetransmissionTimer.For the sake of progress, we suggest retransmission handling issue is avoided by network implementation in Rel-17. The further optimization for reducing system overhead can be left to Rel-18 |
| Huawei, Hisilicon | 1. we think we can at least converge on the application delay for the timer triggered SSSG switching. A proposal for discussion may be needed;
2. For PDCCH skipping, the ZTE’s proposal seems a good proposal between Alt.1a and Alt.1b. We share similar view with Apple that HARQ re-transmission should be handled at least for PDCCH skipping cases when *drx-RetransmissionTimerDL* is running.
3. For SSSG switching, we still have concern on the handling of miss-detection of scheduling DCI indicating SSSG switching. A timer could be configured quite long, how gNB and UE can align the monitored SSSG if Alt.2a is adopted. We have concerns on Alt.2a.

Another thing is we think the proponents’s proposal on proposal 2c does not interact with retransmnission handling, at least based on our reading from contributions. Alt 2c should be should be modified as following with green and to be categorized as a alternative without retransmission handling:**Alt 2c:**for SSSG switching indication via 1-1/1-2, the UE applies the indication [TBD: application delay] ~~1 slot~~ after the last OFDM symbol of HARQ-ACK transmission (ACK or NACK), otherwise the indication is not applied.  |
| Spreadtrum | We share the similar view as CATT that the power saving gain should be maintained with the short application delay, otherwise, why not to use DRX command to stop timers by MAC CE? What we are defining is to use the short time scale controlling on top of DRX command to exploit the additional power saving gain. The PDCCH adaptation in active time is actually the opportunistic slot-level “blanking”, which is still “one-shot”, “memory-less” like other dynamic controls in the scheduling DCI.For the sake of progress, we can live with Alt-1a and Alt-2a. The impact of HARQ-ACK feedback and retransmission can be discussed separately. |
| NEC | We are fine with Alt-1a and Alt-2a. |
| Intel | Our view is having no interaction with HARQ works fine with appropriate gNB implementation. Hence, we suggest to reuse existing design/considerations of application delay as much as possible and relevant and do not spend efforts for optimizations that are not essential.We support Alt 2a for SSSG switchingFor PDCCH skipping, delay should be no more than PDCCH processing delay. Alt1b is consistent with the assumption of time used for PDCCH processing when application delay for cross slot scheduling was defined in Rel-16. Hence, we suggest to go with this. |
| Moderator1 | Clearly majority prefers Alt 2a for SSSG switching. Let’s consider the followings for SSSg switching with additional FFS to address ZTE’s comment for simultaneous usage of Rel-16 cross-slot scheduling and Rel-17 PDCCH monitoring adaptation. The application delay for Rel-16 SSSG switching is independent to whether minimum applicable scheduling offset is configured or not. So moderator encourage companies to take that into account. [High] Proposal 5-1a (v1) – application delay for SSSG switching* Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating SSSG switching (i.e., Beh 2/2A/2B),
	+ **Alt 2a:** the UE applies SSSG switching on an active BWP of the serving cell at a first slot that is at least *Pswitch* symbols after the last symbol of the PDCCH transmission
		- FFS: a minimum applicable scheduling offset is configured in the BWP

For PDCCH skipping, companies are not be able to agree on whether skipping interaction with retransmission or not. Reason for yes: * Prefer to have HARQ re-transmission handled at least for PDCCH skipping cases. Otherwise, likely only very small skipping step will be configured. All the power saving evaluation shows larger skipping step will have bigger UE power saving gain
* If the UL scheduling DCI triggers the skipping, the last PUSCH may contain BSR for higher priority logical channel, thus omitting PDCCH monitoring for re-TX may effect negatively to the service quality

Reason for no:* Alt 1d will induce complicated monitoring behavior, including whether/how to response PDCCH skipping indicator during drx-RetransmissionTimer
* For the sake of progress, we suggest retransmission handling issue is avoided by network implementation in Rel-17.

Considering the situation, it maybe not able to converge at this time. Moderator suggest the followings to move forward.[High] Proposal 5-1b (v1) – application delay for PDCCH skipping* Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating PDCCH skipping (i.e., Beh 1A), select one of the following schemes
	+ **Alt 1a:** the UE applies Beh 1A on an active BWP of the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.
		- FFS: a minimum applicable scheduling offset is configured in the BWP
 |
| IDCC | We are ok with the proposal 5-1a.We prefer to have HARQ interaction for skipping due to the technical reasons already mentioned. We can downselect between Alt 1c and Alt 1d. |
| Samsung  | We share similar way as ZTE, we think Alt1b/2b based on minimum scheduling offset should be reused. Alt2a for R16 SSSG switching is designed for GC-PDCCH based triggering. Since R17 PDCCH adaptation is baed on scheduling DCI, R16 application delay for cross-slot schduling adaptation can be reused. Also, both PDCCH skipping and SSSG switching is triggered by a common indication field in scheduling DCI format, we think a common application delay considering PDCCH processing time make sense.The impact of retransmission for PDCCH skipping can be handled sepereately  |
| Lenovo | Support Proposal 5-1a (v1) and Proposal 5-1b (v1). |
| Nokia\_2 | OK with Proposal 5-1a (v1)For Proposal 5-1b (v1), while typically I would welcome piece-wise agreements, I have slight concern that there will be a push for ‘no conclusion’ not to agree the handling of HARQ/re-TX for PDCCH skipping, thus we would prefer to make a packet agreement as this affects also other procedures as pointed.  |
| Ericsson1 | For SSSG switching, OK with intermediate FL proposal. For skipping, we prefer Alt 1d/1e to ensure retransmission handling is considered. Addditonal behaviour of Alt1d/1e is complementary to Alt 1a. Having proper retransmission handling not only improves overall performance but also increases UE power savings as it enables gNB to be more aggressive when indicating skipping. Since UEs support similar retransmission handling for DRX perhaps companies opposing these alternatives can provide more input on why this leads to ‘complex UE behaviour’.  |
| Xiaomi | Prefer Alt 1a/2a |
| Huawei, HiSilicon | For Proposal 5-1a, as commented for issue#3, we think this is impacted by the decision for the restart condition of the timer. If the timer restarting condition cannot provide a mechanism to fallback from the miss-alignment of monitored SSSG between gNB and UE, we believe the SSSG switching should take effect after the HARQ-ACK. Otherwise, we do not have any protection for the miss-alignment of monitored SSSG. We are fine to compromise to the Proposal 5-1b (v1). However, it would be better to make clear that there can be further discussion on the retransmission handling considering the current situation. At least we have some progress regarding the application delay by the proposal 5-1b. Some suggestions on the revision are provided.[High] Proposal 5-1b (v1) – revised by HW* Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating PDCCH skipping (i.e., Beh 1A), select one of the following schemes
	+ **Alt 1a:** the UE applies Beh 1A on an active BWP of the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.
		- FFS: a minimum applicable scheduling offset is configured in the BWP
		- FFS: retransmission handling
 |

## Issues#6: Miscellaneous

### Initial proposals for RAN1#108

1. **NR-U**

The procedures in section 10.4 are not applicable if *searchSpaceGroupIdList* (for Rel-16) is not configured. However, the description of Rel-17 PDCCH monitoring adaptation is also captured in section 10.4. Therefore, the procedures of Rel-17 PDCCH monitoring adaptation will not be valid because of the restriction. To enable the Rel-17 PDCCH monitoring adaptation, the following proposal is proposed.

#### [Medium] proposal 6-1(v1) – NR-U

|  |
| --- |
| **Proposed by ZTE**TS 38.213**<Unchanged parts are omitted>**10.4 Search space set group switching and skipping of PDCCH monitoringA UE can be provided a group index for a respective Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList* or *searchSpaceGroupIdList\_r17* for PDCCH monitoring on a serving cell. And a UE can be provided a set of durations by *PDCCHSkippingDurationList* for PDCCH monitoring on a serving cell. If the UE is not provided *searchSpaceGroupIdList* or *searchSpaceGroupIdList\_r17* for a search space set, and the UE is not provided *PDCCHSkippingDurationList* for PDCCH monitoring on a serving cell, the following procedures are not applicable for PDCCH monitoring according to the search space set.**<Unchanged parts are omitted>** |

1. **BWP**

#### [Medium] Proposal 6-2a (v1) – BWP

Proposed by Huawei/HiSi, OPPO, Xiaomi, ZTE

No: CATT, Apple

|  |
| --- |
| In case of a scheduling DCI indicating PDCCH monitoring adaptation and BWP switching simultaneously, * If PDCCH skipping is indicated, PDCCH skipping duration starts after BWP switching delay;
* If SSSG switching is indicated, the indicated SSSG takes effect after BWP switching delay.
 |

#### [Medium] Proposal 6-2b (v1) – BWP

Proposed by Ericsson, Huawei/HiSi, MTK, ZTE(with modification)

No: CATT, Apple

|  |
| --- |
| **Proposed by Huawei, OPPO**If the active BWP is switched due to the expiration of bwp-InactivityTimer before the end of the PDCCH skipping duration, the default behavior on the new active BWP, i.e., default BWP, is * UE starts monitoring PDCCH according to configured SS sets if SSSG is not configured on the new active BWP;
* UE starts monitoring PDCCH according to SS set in SSSG0 if SSSG is configured on the new active BWP.

**Proposed by MTK**If UE changes an active DL BWP due to a BWP inactivity timer expiration, UE monitors PDCCH, assuming PDCCH monitoring adaptation field of value zero, after the active DL BWP change. |

#### [Medium] Proposal 6-2c (v1) – BWP

Proposed by Ericsson

No: CATT, Apple

|  |
| --- |
| * [When the source BWP is not configured with PDCCH monitoring adaptation and the target BWP is configured with PDCCH monitoring adaptation, the target BWP starts with the default state (e.g., SSSG0).](#_Toc95739260)
* [When the source BWP is configured with PDCCH monitoring adaptation and the target BWP is not configured with PDCCH monitoring adaptation, the PDCCH monitoring adaptation bitfield when BWP-switching indicated, is ignored.](#_Toc95739261)
 |

1. **PDCCH monitoring Case 5**

Case 5 (i.e., 3 SSSG switching and skipping) is supported.

* + 2-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors
		- 00 is Beh 2
		- 01 is Beh 2A
		- 10 is Beh 2B
		- 11 is Beh 1A (stay in current SSSG)
	+ Note: for 00, 01 and 00, UE performs Beh 1(i.e., does not perform PDCCH skipping )
* Support case 5:
	+ **DOCOMO, OPPO Panasonic, CATT, LGE**
* Not support case 5:
	+ **ETRI, Apple, ZTE, MTK, Huawei**
* Unclear

#### [Medium] Proposal 6-3 (v1) - support case 5

|  |
| --- |
| Case 5 (i.e., 3 SSSG switching and skipping) is supported.* + 2-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors
		- 00 is Beh 2
		- 01 is Beh 2A
		- 10 is Beh 2B
		- 11 is Beh 1A (stay in current SSSG)
	+ Note: for 00, 01 and 00, UE performs Beh 1(i.e., does not perform PDCCH skipping )
 |

1. **Handling of indication change**

**Samsung- handling of indication change**

If a UE detects a DCI format that include a PDCCH monitoring adaptation indication in slot n, the indication shall be applied in slot n + X of scheduling cell. The application delay, X, is determined in Clause 5.3.1 of TS 38. The UE does not expect to be scheduled with a DCI format with PDCCH monitoring adaptation indication field indication a different value of PDCCH monitoring adaptation indication for the same active BWP before slot n + X of the scheduling cell.

**Vivo - handling of indication change**

**Proposal 10: adopt the following text proposals in TS38.213**

**When the UE is scheduled with DCI format 0\_1 /1\_1/0\_2/1\_2 with a 'PDCCH monitoring adaptation indication’ field in slot *n*, the UE does not expect to be scheduled 0\_1 /1\_1/0\_2/1\_2 with a 'PDCCH monitoring adaptation indication’ field indicating change to another SSSG or skipping for the same active BWP of the scheduling cell before slot *n+X* of the scheduling cell, where X is the value of the application delay.**

**ZTE- handling of indication change**

[Proposal 13: UE does not expect to be scheduled with DCI format with ‘PDCCH monitoring adaptation’ field indicating another change to PDCCH monitoring behavior for the same active BWP before the previous indication applied.](#_Toc7778)

**CATT - handling of indication change**

***Proposal 2：If UE is indicated in skipping an interval of the PDCCH monitoring, UE would keep skipping the interval of PDCCH monitoring and monitor the PDCCH at the next PDCCH monitoring occasion after the skipping interval until UE receives a new PDCCH skipping indication.***

Corresponding TP is provided in Proposal 3

#### [Medium] Proposal 6-4 (v1) – handling of indication change

***FL recommendations:*** FL suggest to consider the TP from Samsung, vivo and CATT

|  |
| --- |
| **Proposed by Samsung**If a UE detects a DCI format that include a PDCCH monitoring adaptation indication in slot n, the indication shall be applied in slot n + X of scheduling cell. The application delay, X, is determined in Clause 5.3.1 of TS 38. The UE does not expect to be scheduled with a DCI format with PDCCH monitoring adaptation indication field indication a different value of PDCCH monitoring adaptation indication for the same active BWP before slot n + X of the scheduling cell.**Proposed by vivo****When the UE is scheduled with DCI format 0\_1 /1\_1/0\_2/1\_2 with a 'PDCCH monitoring adaptation indication’ field in slot *n*, the UE does not expect to be scheduled 0\_1 /1\_1/0\_2/1\_2 with a 'PDCCH monitoring adaptation indication’ field indicating change to another SSSG or skipping for the same active BWP of the scheduling cell before slot *n+X* of the scheduling cell, where X is the value of the application delay.****Proposed by CATT**When UE is indicated skipping PDCCH monitoring for a duration in a DCI format 0\_1, DCI format 1\_1, DCI format 0\_2, and/or DCI format 1\_2, UE would keep skipping the indicated interval until UE receives a new PDCCH skipping indication. |

1. **DRX-timers**

**Nokia**

**Proposal:** **PDCCH skipping duration expires upon expiry of inactivity timer (*drx-InactivityTimer*). When inactivity timer expires, UE falls back to default SSSG (or to configured SSSG).**

#### [Medium] Proposal 6-5 (v1) – DRX timer impact

***FL recommendations:*** FL suggest to consider the followings, should minimize additional specification impact.

|  |
| --- |
| **Proposed by Nokia**PDCCH skipping duration expires upon expiry of inactivity timer (*drx-InactivityTimer*). When inactivity timer expires, UE falls back to default SSSG (or to configured SSSG). |

1. **Others**

**Ericsson - SSSG switching triggered by SR, Configuring of SSSG at the start of onDuration**

Proposal 5: UL scheduling request can be used as an implicit indication for PDCCH monitoring adaptation (to end the skipping or to switch to an SSSG). The SSSG (if configured) that UE monitors after transmitting an UL scheduling request is configurable by NW.

Proposal 6: For UE configured with DRX, higher layer signaling can configure SSSG that a UE monitors when coming out of DRX to monitor an ON duration.

**Huawei - SSSG switching triggered by SR and RACH**

***Proposal 13: Support SSSG switching triggered by SR and RACH.***

**NEC - Configuration**

**Proposal 1: Support RRC parameter configured for the PDCCH monitoring adaptation indication field presence/absence in DCI format x-2.**

**Proposal 2: Support PDCCH monitoring skipping duration as multiple of** **PDCCH monitoring periodicity.**

**Proposal 3: Support consecutive PDCCH monitoring in multi-slot steps during*****Ts* for UE Power Saving.**

**Nokia - Configuring of SSSG at the start of onDuration when the inactivity timer has expired.**

**Proposal:** **Consider support configuring of SSSG that is applied at the start of onDuration when the inactivity timer has expired.**

**Observation:** *Associating a minimum scheduling offset value with a specific SSSG can reduce the signaling and enhance UE power saving and/or data delay.*

**Proposal: RAN1 to define a minimum scheduling offset (K0,min/K2,min) per SSSG.**

**OPPO- handling of SSSG switching and cross-slot scheduling**

***Proposal 3: The search space group switching indication in the DCI can also trigger cross-slot scheduling states.***

***In that case, the application delay of cross-slot is also applicable.***

### Companies views (1st round)

|  |  |
| --- | --- |
| Company | Comments |
| CATT | Proposal 6-1: The associated text for Rel-17 is in the same section. Thus, this CR is not needed.Proposal 6-2: PDCCH monitoring adaptation is configured per BWP. The BWP switching would reset the PDCCH monitoring adaptation. We don’t support the proposals 6-2a, 6-2b and 6-2c.Proposal 6-3: We are OK to discuss further.Proposal 6-4: This is an essential correction to identify the UE behavior before UE receives next PDCCH skipping indication. Proposal 6-5: We don’t agree the fall back to SSSG#0 at each DRX cycle.  |
| Apple | 6-1: interaction between NR-U SSSG feature and R17 feature is discussed in different session. 6-2: Configuration is per BWP. Clarifications do not seem to be needed.6-3: do not support case 5. 6-4: Seems to related to discussion of proposal 5-1. 6-5: Further discussion whether SSSG reset every DRX cycle.  |
| ZTE, Sanechips | OK with proposal 6-1OK for proposal 6-2a, 6-2b with minor changes.

|  |
| --- |
| If the active BWP is switched due to the expiration of bwp-InactivityTimer ~~before the end of the PDCCH skipping duration~~, the default behavior on the new active BWP, i.e., default BWP, is * UE starts monitoring PDCCH according to configured SS sets if SSSG is not configured on the new active BWP;
* UE starts monitoring PDCCH according to SS set in SSSG0 if SSSG is configured on the new active BWP.
 |

 For 6-2c, we think current procedure of BWP switching can solve the problem and it does not need further discussion.

|  |
| --- |
| 38.213If a bandwidth part indicator field is configured in a DCI format and indicates an UL BWP or a DL BWP different from the active UL BWP or DL BWP, respectively, the UE shall- for each information field in the DCI format - if the size of the information field is smaller than the one required for the DCI format interpretation for the UL BWP or DL BWP that is indicated by the bandwidth part indicator, the UE prepends zeros to the information field until its size is the one required for the interpretation of the information field for the UL BWP or DL BWP prior to interpreting the DCI format information fields, respectively- if the size of the information field is larger than the one required for the DCI format interpretation for the UL BWP or DL BWP that is indicated by the bandwidth part indicator, the UE uses a number of least significant bits of the DCI format equal to the one required for the UL BWP or DL BWP indicated by bandwidth part indicator prior to interpreting the DCI format information fields, respectively- set the active UL BWP or DL BWP to the UL BWP or DL BWP indicated by the bandwidth part indicator in the DCI format  |

Not support proposal 6-3.OK to discuss proposal 6-4. Proposal from vivo is preferred.For proposal 6-5, okay with the proposal in principle. it can be also discussed together with the Issues#7. |
| LGE | Proposal 6-1: It is discussed in different session.Proposal 6-2: We think it is still unclear what UE's default monitoring behavior when starting drx-onDurationTimer. If BWP switching and PDCCH monitoring adaptation can be indicated simultaneously, UE need to follow default monitoring behavior.Proposal 6-3: Fine to discuss further.Proposal 6-4: It seems to be clarfied. We are okay to discuss further.Proposal 6-5: Not only PDCCH skipping but also SSSG switching should expires upon epxiry of drx-InactivityTimer. We would like to emphasize that PDCCH monitoring adaptation is only applied during DRX Active Time as can be seen from WID. |
| MediaTek | Proposal 6-1: Fine with this proposalProposal 6-2: We are open to discuss the interation between BWP and power saving adaptation and suggest lower priority on this issue. Proposal 6-3: Not support case 5Proposal 6-4: Not support. In Rel-16 NR-U, UE still monitor PDCCH during the application delay. There is no need to limit it.Proposal 6-5: Not support. The default SSSG can be configured to be a SSSG with dense/sparser MOs. In our view, it is not necessary to reset it every DRX cycle. |
| Huawei, HiSilicon | proposal 6-1(v1): support;Proposal 6-2a (v1): support;Proposal 6-2b (v1): prefer the proposal by HW, OPPO;Proposal 6-2c (v1): OK.Proposal 6-3 (v1): not OK. We don’t agree this during CR phase. The RRC parameter list for power saving is also expected not to be impacted in this meeting. Proposal 6-4 (v1): we support vivo’s version, which is clearer.Proposal 6-5 (v1): we have concern on it. This would add more complicated implementation on UE side, e.g. to introduce new indication from MAC to PHY layer. |
| NEC | Fine with not to change the RRC parameter. There should be at least a CR on ‘consecutive PDCCH monitoring in multi-slot steps’ during Ts for higher SCS cases. |
| Intel | OK with P 6-1OK with P 6-2, proposals seem reasonableDo not support P 6-3 Support vivo’s version in P 6-4P 6-5. We think upon expiry of inactivity timer, MAC specification procedure is clear. So we do not support current version. It is sufficient to capture that if inactivity timer expires before PDCCH skipping duration ends, UE skips current DRX cycle. Please refer to our proposal 8. It can be a conclusion too.**Proposal 8: DRX inactivity timer continues to decrement and if expires during skipping duration, UE skips the current DRX cycle.** |
| Moderator 1 | For proposal 6-1,The current Text in TS38.213 says as follows,A UE can be provided a group index for a respective Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList* for PDCCH monitoring on a serving cell. If the UE is not provided *searchSpaceGroupIdList* for a search space set, the following procedures are not applicable for PDCCH monitoring according to the search space set.Hence if the UE is not configured with *searchSpaceGroupIdList* -r17, all the remaining text in this section is not applicable. This is clearly not true.To Apple and CATT, I think ZTE’s proposal has no intention to talk about interaction of NR-U SSSG feature and R17 feature.For proposal 6-2, it seems more discussion and clarification are needed.For proposal 6-3, it is controversial to support case 5. Hence moderator to conclude this as follows,[Medium] Proposal 6-3 (v2) - support case 5RAN1 has no consensus to support PDCCH monidtoring case 5 (i.e., 3 SSSG switching and skipping)For Proposal 6-4, many companies thinks it is needed. Reply to MTK’s comment, the proposal 6-4 does not forbid PDCCH monitoring during the application delay, but it is to limit that UE is not expect to receive different PDCCH monitoring indication during application delay.For proposal 6-5, it seems more discussion and clarification are needed. |
| Nokia\_2 | Appologizes for skipping the medium proposals on first round.For proposal 6-1; OKFor proposals 6-2x -BWP; * For DCI based, it would be good to clarify that the target configuration is applied. I.e. if the target BWP does not have PDCCH monitoring adaptation configuration, no adaptation should be applied.
* For timer based, falling to default/normal monitoring should be assumed

For proposals 6-3; while technical justification to omit this option still evades me, we are fine to go with the majority view.For proposals 6-4; we can further discuss the “adaptation prohibit timer” for the duration of the application delay.For proposals 6-5; like raised in our contribution, current WID determines that PDCCH monitoring adaptation applies only during C-DRX Active Time and RAN1 has not made any agreement to extend this beyond this. To simplify the design and interaction with MAC we proposed basically to stop PDCCH monitoring adaptation. If we don’t apply this we need to address all the related artefacts (with possible interaction with MAC).  |
| Ericsson1 | 6-1 : OK in principle, but only need to reflect the skipping parameter. There is no need to reflect the search space group list with suffix as existing text covers both r16 and r17.6-3 : OK with moderator intermediate proposal 6-3(v2)6-4 : Need to converge on the application delay aspect first. Also, meaning of same/different monitoring indication needs to be clarified.  |
| Xiaomi | For proposal 6-1/ 6-2a/6-4(Samsung)/6-5(Nokia): OKFor proposal 6-2b/2c: if bwp switch and PDCCH monitoring adapatation is indicated in the same DCI, we think it is more reasonable to let UE follow the instruction of PDCCH monitoring adapatation indication in the new BWP instead of going to a default state. |

## Issues#7: RAN2 LS - (R1-2200884)

### Initial proposals for RAN1#108

#### Question 1

**Question 1:** RAN2 would like to know whether PDCCH skipping is applied to RNTI(s) monitored during RAR/MsgB window for RAR/MsgB reception.

Companies stated that it should notify RAN2 that RAN1 agrees PDCCH based monitoring adaptation is applied for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets. Hence, if there are any RNTI(s) in Type3-PDCCH CSS sets or USS sets during RAR/MsgB window for RAR/MsgB reception, it will be impacted by PDCCH skipping. Most companies agrees that it should be avoided to skips all or at least some of the PDCCH monitoring in Type3-PDCCH CSS sets or USS sets during RAR/MsgB window for RAR/MsgB reception. And if RAN1 agrees to further cases where PDCCH skipping is applicable, RAN1 can reply accordingly.

***FL recommendations:*** considering the followings in response to Question 1

#### [High] Proposal 7-1 (v1)

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| --- |
| **Answer 1 for** **R1-2200884 (R2-2201960):** RAN1 agrees PDCCH based monitoring adaptation is applied for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets. Hence, if there are any RNTI(s) for UE to monitor in Type3-PDCCH CSS sets or USS sets during RAR/MsgB window for RAR/MsgB reception, it will be impacted by PDCCH skipping.RAN1 will further discuss and how to capture it in the RAN1 specification according to RAN2 agreements. And if RAN1 agrees to further cases where PDCCH skipping is applicable/not applicable, RAN1 can reply accordingly. |

#### Question 2

**Question 2: RAN2 would like to know if RAN1 prefers to capture the above agreements in RAN1 specification or prefer these to be captured in MAC specification.**

Capture in RAN1 spec:

* vivo, ZTE/Sanechip, CATT, Ericsson, Samsung, MTK, LGE, Huawei(only SR and RAR/MsgB), Intel

Capture in RAN2 MAC spec:

* CMCC, Huawei (only contention resolution timer), Qualcomm, Nordic(SR)

***FL recommendations:*** considering majority companies prefer to capture it in RAN1 spec, it is therefore proposed as follows,

#### [High] Proposal 7-2 (v1)

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| --- |
| **Answer 2 for R1-2200884 (R2-2201960):** RAN1 prefers to capture the above RAN2 agreements in RAN1 specification. |

#### Question 3

* Approach 1: If UE can not monitor DCP due to PDCCH skipping, physical layer of UE does not report Wake-up indication bit to higher layer. Higher layer reuses the ps-Wakeup to determine whether to start the drx-onDurationTimer or not.
* Approach 2: If UE can not monitor DCP due to PDCCH skipping, physical layer of UE reports a value of 1 for Wake-up indication bit to higher layer.
* Approach 3: PDCCH skipping only applies in Active Time and hence DCP cannot be missed due to PDCCH skipping.

**Question 3: RAN2 would like to ask RAN1 whether a) Physical layer of UE reports a value of 1 for Wake-up indication bit to higher layer or b) Physical layer of UE does not report Wake-up indication bit to higher layer, in case UE cannot monitor DCP due to PDCCH skipping; or if Approach 3 can be assumed.**

**Approach 1: Ericsson**

* Reason: Straightforward to follow legacy behavior, i.e. for the UE to not report the Wake-up indication bit to the higher layer. Higher layer can reuse ps-Wakeup to determine whether to start the drx-onDurationTimer.

**Approach 2: vivo, MTK, Huawei/HiSilicon, Apple**

* Reason: the current specification already defines the UE behaviour when UE is not required to monitoring wake-up signal. It is approach 2, so no additional specification impact is needed.

**Approach 3: CATT, CMCC, Samsung, LGE, IDC, Nokia/NSB, Qualcomm, Nordic, ZTE**

* Reason: DRX is configured when DCP is configured, and the PDCCH skipping is applied for active time. Since DCP is outside active time, it should not be impacted.

***FL recommendations:*** Considering majority companies prefer to approach 2 or 3, FL suggest companies to consider these two approaches.

RAN1 has not concluded whether skipping duration is extended beyond C-DRX Active time. However, if DCP monitoring would collide with PDCCH skipping duration, RAN1 specification defines that if UE is not required to monitor PDCCH for detection of DCI format 2\_6 (as described in clauses 10, 11.1, 12, and in clause 5.7 of [11, TS 38.321]) UE reports a value of 1 for the Wake-up indication bit to higher layers for the next long DRX cycle as described in Approach 2.

#### [High] Proposal 7-3 (v1)

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| --- |
| **Answer 3 for R1-2200884 (R2-2201960):** RAN1 has not concluded whether skipping duration is extended beyond C-DRX Active time. However, if DCP monitoring would collide with PDCCH skipping duration, RAN1 specification defines that if UE is not required to monitor PDCCH for detection of DCI format 2\_6 (as described in clauses 10, 11.1, 12, and in clause 5.7 of [11, TS 38.321]) UE reports a value of 1 for the Wake-up indication bit to higher layers for the next long DRX cycle as described in Approach 2. Thus no additional RAN1 specification impact is needed. |

#### Question 4

**Question 4: RAN2 would like to know whether UE should continue transmitting CSI/SRS during the PDCCH skipping duration or not?**

RAN1 has not agreed that PDCCH monitoring adaptation has impact to UE behavior regarding CSI-RS reception or SRS transmission. Thus, UE should continue transmitting/receiving periodic/semi-static CSI-RS/SRS during PDCCH skipping duration. Considering majority companies think UE continue transmitting CSI report/SRS during the PDCCH skipping duration. LGE, Qualcomm think AN1 should continue study to skip transmitting CSI/SRS.

***FL recommendations:*** to agree on the following

#### [High] Proposal 7-4 (v1)

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| --- |
| **Answer 4 for R1-2200884 (R2-2201960):** It is RAN1’s understanding that UE should continue transmitting CSI report/SRS during the PDCCH skipping duration.  |

#### Update of RAN1 specification to capture RAN2 agreements

RAN2 has discussed the impact of PDCCH skipping on SR and RA procedure. Following agreements were made in RAN2#116bis-e:

1. UE ignores PDCCH skipping while the SR is pending.
2. If PDCCH skipping is applied to RNTI(s) monitored during RAR/MsgB window, the UE ignores PDCCH skipping during the RAR/MsgB window.
3. UE ignores PDCCH skipping while contention resolution timer is running.

Followed by these RAN2'sunderstanding, and majority companies agree to capture it in the RAN1 specification, the following is propose for RAN1

***FL recommendations:*** to agree on the following

#### [High] Proposal 7-5 (v1) - RAR/MsgB/Msg4

|  |
| --- |
| - PDCCH skipping is not applied to PDCCH monitoring for RAR reception during RAR window- PDCCH skipping is not applied to PDCCH monitoring for MsgB reception during MsgB window- PDCCH skipping is not applied to PDCCH monitoring for Msg 4 reception during contention resolution timerFFS how to capture the above agreements in RAN1 specification |

For proposal 7-5, some companies propose further details regarding to specification impact, considering the detail specification change also depends on the outcome of proposal 2-1. It can be decided later on.

**Samsung**

PDCCH skipping is applied to C-RNTI monitored in a USS set associated with *recoverySearchSpaceId* for RAR triggered for BFR. Additional RAN1 specification work is needed to support ignoring of PDCCH skipping for RAR reception as per RAN2 agreement.

**Intel**

PDCCH skipping does not apply to search space set provided by recoverySearchSpaceId

When the UE is indicated to skip PDCCH monitoring for a duration on a serving cell, the UE skips monitoring of PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in Type3 CSS and USS, except when SR is pending, contention resolution timer is running, or RAR window is not expired.

**vivo**

Agree the following conclusions and capture it in the TS38.213.

* If a UE received a DCI format indicating skipping PDCCH monitoring for a duration that overlaps with at least one symbol of a window provided by *ra-ResponseWindow* or *msgB-ResponseWindow* orthe duration where *ra-ContentionResolutionTimer* is running which is controlled by higher layers [11, TS 38.321], the UE skips monitoring PDCCH according to Type3-PDCCH CSS sets or USS sets on the serving cell, except for monitoring a DCI format in response to
	+ a PRACH transmission, or
	+ a transmission of a PRACH and a PUSCH, or to a transmission of only a PRACH if the PRACH preamble is mapped to a valid PUSCH occasion, or
	+ a PUSCH transmission scheduled by a RAR UL grant

**IDC**

 *Support implicit PDCCH monitoring adaptation triggered by SR and RACH*

* + *Discuss whether and how to define a monitoring window for a UL grant regarding SR*

**Nokia**

* PDCCH monitoring skipping is not applied to Type2-PDCCH CSS where DCI format with CRC scrambled with a RA-RNTI, a MsgB-RNTI, or a TC-RNTI is monitored during RAR/MsgB window.
* RAN1 also notes that in case of CFRA based BFR, UE monitors PDCCH in recoverySearchSpaceId until the UE receives MAC CE configuring UE with new PDCCH beam or timer *beamFailureRecoveryTimer* expires. To ensure proper BFR handling, RAN1 agreed to stop skipping and resume normal PDCCH monitoring upon RACH triggering.

**Qualcomm**

Monitoring of PDCCH candidate for DCI formats with CRC scrambled by SI-RNTI, RA-RNTI, MsgB-RNTI, or P-RNTI is not affected by PDCCH skipping.

#### [High] Proposal 7-6 (v1) - SR

***FL recommendations:*** based on the received comments, companies are agreed to capture SR based PDCCH skipping in RAN1 specification. However, not too much companies provides how to capture. Companies are encouraged to check the followings.

|  |
| --- |
| **Capture the followings in the TS38.213.**- If the UE is indicated skipping PDCCH monitoring for a duration and at the first slot after the last OFDM symbol of a positive SR transmission, the UE stops PDCCH skipping (i.e., PDCCH skipping is not activated ). |

#### Others

PDCCH skipping can be applied to Type 3 CSS as follows,

- a Type3-PDCCH CSS set configured by

- *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *common* for DCI formats with CRC scrambled by INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, or CI-RNTI and, only for the primary cell, C-RNTI, MCS-C-RNTI, CS-RNTI(s), or PS-RNTI, or

- *SearchSpace-Multicast* in *PDCCH-Config-Multicast* for DCI formats with CRC scrambled by G-RNTI, or G-CS-RNTI, or

- *searchSpaceBroadcast* in *pdcch-Config-MCCH* and *pdcch-Config-MTCH* on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI, and

**Proposed by vivo**

**Proposal 7: Agree the following conclusions and capture it in the TS38.213.**

**If a UE is indicated to skip PDCH for a duration, the UE skips monitoring PDCCH according to Type3-PDCCH CSS sets or USS sets on the serving cell, except for monitoring a DCI format with CRC scrambled by G-RNTI, or G-CS-RNTI, or MCCH-RNTI.**

### Companies views (1st round)

|  |  |
| --- | --- |
| Company | Comments |
| CATT | Proposals 7-1 and 7-2: In CATT’s contribution R1-2201321, we had provided the analysis of PDCCH skipping and RAR/MsgB window are two independent events. They are mostly implementation issues without any specification. We don’t agree with answers in Proposal 7-1 and 7-2Proposal 7-3: PDCCH skipping only applies to DCI formats in Active Time. There is no interaction with DCI format 2\_6. We should conclude no interaction in Proposal 7-3.Proposal 7-4: SupportProposal 7-5: ObjectProposal 7-6: This is an implementation issue. We don’t agree with the proposal.Proposal 7: We don’t agree with the proposal.  |
| Nordic | 7-1 RAR/MSGB is monitored in TYPE1 SS, which is not impacted by PDCCH skipping currently7-2 RAN2-Agreements 1 could be captured in RAN2 spec, Agreements 2/3 is not needed as there is no interaction of PDCCH skipping with TYPE1 search-space currently7-3 we support Approach 37-4 Anwer to question is Yes7-5 as said RAN2-Agreements 1should be captured in 38.3217-6 Not support   |
| Apple | OK with proposal 7-3 and 7-4. Do not support 7-6. Has been discussed in RAN1 for long time without agreement. 7-1 and 7-5 are related to issue 2-2 |
| ZTE, Sanechips | For proposal 7-1, if the intention is to capture Ran2 agreeements in Ran1 spec, we are okay.For proposal 7-2, OK.For proposal 7-3, we prefer that PDCCH skipping is not applied to DCI format 2-6. However, Approach 3 is also OK.Proposal 7-4, OK.Proposal 7-5, OK.Proposal 7-6, we think the intention been agreed according to RAN 2LS. Following update is suggested to make it clear.If the UE is ~~indicated~~ skipping PDCCH monitoring for a duration and at the first slot after the last OFDM symbol of a positive SR transmission, the UE stops PDCCH skipping (i.e., PDCCH skipping is not activated ). |
| Qualcomm | Proposal 7-1 and Proposal 7-5: During RAR/MsgB window, UE monitors Type1 CSS. Since it is RAN1’s understanding that monitoring of broadcast PDCCHs should not be affected by PDCCH skipping, we could simply answer that Type1 CSS monitoring is not affected by PDCCH skipping.Proposal 7-2 and Proposal 7-6: RAN2’s agreements are describing MAC procedures, such as SR and contention resolution. Thus, it could be captured in MAC specification.Proposal 7-3: As we commented in Issue#2, Proposal 2-1, we can list all PDCCH types (RNTI’s) that are impacted by PDCCH skipping, such as C-RNTI, MCS-C-RNTI, CS-RNTI, CI-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, TPC-SRS-RNTI, or AI-RNTI. By not including PS-RNTI in the list, Approach 3 naturally follows.Proposal 7-4: We are fine with the proposal. |
| Nokia\_1 | **On Proposal 7-1 and 7-2**; We did not indicate preference whether to capture these in RAN1 or in RAN2 spesification, as the feasibility depends bit on extent of the agreements we make. Now SR is noted in RAN1 spec in PUCCH multiplexing, but over all SR procedure is under RAN2 spesification (covering also case when RACH is triggered). Thus it is not fully clear whether capturing SR related behaviour in RAN1 spesification is the best approach (though possible).RACH procedure from physical layers is covered in RAN1, while RAN2 also has significant portion of the procedure. Also, as noted in our contribution, for RACH RAN2 has focused to CBRA, but CFRA procedure is an option especially for BFR (e.g. *recoverySearchSpaceId* maps to USS). As RACH can be triggered due to different procedures, e.g. SR and BFR, it is not clear if it is feasible just to stop the PDCCH skipping for the duration of e.g. ra-ContentionResolutionTimer, to ensure proper handling of all procedures to keep the quality of service. Thus, for RACH we would propose that RAN1 agrees that upon triggering RACH, UE cancels the skipping.**On proposal 7-3**; From WID description it would seem that PDCCH monitoring adaptation is not extended beyond C-DRX Active time. So far RAN1 has not agreed that the PDCCH montoring adaptation is applied outside C-DRX Active time, thus our preference would be to follow the Approach 3 in RAN2 LS.RAN1 should also agree what the the behaviour when C-DRX inactivity timer expires. Simplest would be if associated timers/durations would expire. As noted, from DCP perspective no additional agreement is needed, as current specification sets that if DCP monitoring is omitted due to Clause 10 (among others), UE will indicate wake-up for higher layers. Hence, we would first propose to try to confirm that PDCCH monitoring adaptation is not applied outside Active time to conclude the discussion and then derive the response to RAN2. **On proposal 7-4**; Agree, we think that this is clear based on existing agreements. **On proposal 7-5**; Like noted above we should also consider the contention free RACH procedure. Also ‘stopping the skipping’ only for the duration of the said timer/window may not ensure that all related procedures are completed successfully. Hence, we would suggest to cancel/stop PDCCH skipping when RACH (CBRA or CFRA) is triggered.**On proposal 7-6**; while I agree with the intent of the proposal, it is not clear whether this considers both RACH and PUCCH based SR?  |
| LGE | Proposal 7-1: RA-RNTI, MsgB-RNTI and TC-RNTI are obviously not impacted by PDCCH skipping. If there is any RNTI(s) impacted by PDCCH skipping, it should be C-RNTI for RAR BFR.Proposal 7-2: Fine with the proposal.Proposal 7-3: As can be seen from WID, the objective of this work item is Rel-16 DCI-based power saving adaptation during DRX Active Time. * 1. Study and specify, if agreed, extension(s) to Rel-16 DCI-based power saving adaptation **during DRX Active Time** for an active BWP, including PDCCH monitoring reduction when C-DRX is configured [RAN1]

Thus, we should conclude collision of skipping duration and DCP occasion. Proposal 7-4: If CSI/SRS transmission is stopped in skipping duration, we expect more power saving gain.Proposal 7-5: Need more discussion as it is related to issue 2-2.Proposal 7-6: The wording ‘SR is pending’ in RAN2 agreements is somewhat vague, so it's fine as a clear statement of when the UE will start to stop PDCCH skipping. |
| MediaTek | On Proposals 7-1 and 7-2, we suggest to move 2nd paragraph to Proposal 7-2 and remove the 2nd sentence.On Proposal 7-3, we are supportive of the response with Approach 2 since this is the only UE behavor irrelevant to whether PDCCH skipping is restricted to active time or not.* Even if PDCCH skipping is restricted to active time, there can be a case where PDCCH skipping takes effect during inactivity timer while DCP is not monitored due to overlapping with the running inactivity timer. The description of TS 38.213 still applies and gives the same behavor as Approach 2.

On Proposal 7-4, we suggest to include the fundamental reason: PDCCH only applies to adapting PDCCH monitoring; so no other operations will be impacted.On Proposal 7-5/7-6: We suggest to “terminate” PDCCH skipping if RAR/MsgB/contention resolution timer window is running or SR is pending.For the specification capturing, we also suggest leaving it to spec editor so that the group can process other fundamental issues. |
| Huawei, HiSilicon | Proposal 7-1: RAN2 does not ask anything about Type3-PDCCH CSS sets or USS sets. We don’t think we should reply with this irrelevant information in the reply.Proposal 7-2: OK to capture them in RAN1.Proposal 7-3: OK.Proposal 7-4: we prefer to further discuss it which may have power saving impact. Proposal 7-5: do we need this? if we could agree proposal 7-2 to capture them in RAN1?Proposal 7-6: OK.  |

|  |  |
| --- | --- |
| Panasonic | On 7-1, we are okay.On 7-2, okay.On 7-3, we think approach 3 is more sensible than approach 2. PDCCH skipping does not impact DCP at all.On 7-4, we are okay.On 7-5, before agreeing on the answer, we need to address whether PDCCH skipping is applied to Type 0/0A/1/2 CSS.On 7-6, a sensible gNB should check SR resource first and then decides whether to indicate PDCCH skipping. So it is not so necessary to specify such UE behaviour. In addition, we support not to apply PDCCH skipping to Type 0/0A/1/2 CSS, which can also resolve this potential error for system stability. |
| Intel | P 7-1, P 7-5, P 7-6 and TP for issue # 2 are partially relevant. So we suggest to discuss them together and come up with a joint TP including exception handling. We do not agree that msgb-window or ra-window cannot be captured in 213. A reference to 38.213 can be made. Please see our suggestion to issue # 2. As an example, we agreed the following for WUS monitoring and referred to MAC spec for details “The UE does not monitor PDCCH for detecting DCI format 2\_6 during Active Time [11, TS 38.321]”Support P 7-2Support P 7-3Support P 7-4 |

|  |  |
| --- | --- |
| Moderator 1 | **For proposal 7-1 ~ 7-4,**For Question 1, Nokia, Samsung, LGE stated that RA-RNTI, MsgB-RNTI and TC-RNTI are obviously not impacted by PDCCH skipping. If there is any RNTI(s) impacted by PDCCH skipping, it should be C-RNTI, e.g., for RAR BFR. To have a complete list, moderator suggest companies to check the followings cases(scrambled by C-RNTI) whether they are impacted by RAN1 PDCCH skipping but RAN2 agreement try to avoid this:* For CFRA 4-step RACH procedure, PDCCH for BFR RAR scrambled by C-RNTI can be in recovery SS (USS),
* For CBRA 4-step RACH procedure, PDCCH for Msg4 scrambled by C-RNTI can be in any SS,
* For CFRA 2-step RACH, PDCCH for RAR scrambled by C-RNTI for HO only,
* For CBRA 2-step RACH, PDCCH for BFR RAR scrambled by C-RNTI can be in any SS

For Question 2, majority companies prefer to capture it in RAN1. For Question 3, majority companies seem to prefer approach 3.For Question 4, majority companies think the answer is yes, while LGE and Huawei prefer to further discuss whether PDCCH skipping CSI/SRS transmission.[High] Proposal 7-1 ~ 7-4 (v2)**Answer 1 for R1-2200884 (R2-2201960):** It is RAN1 understanding that C-RNTI(s) monitored ~~agrees PDCCH based monitoring adaptation is applied for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets. Hence, if there are any RNTI(s) for UE to monitor in Type3-PDCCH CSS sets or USS sets~~ during RAR/MsgB window for RAR/MsgB reception~~, it~~ will be impacted by PDCCH skipping.~~RAN1 will further discuss and how to capture it in the RAN1 specification according to RAN2 agreements. And if RAN1 agrees to further cases where PDCCH skipping is applicable/not applicable, RAN1 can reply accordingly.~~**Answer 2 for R1-2200884 (R2-2201960):** RAN1 prefers to capture the above RAN2 agreements in RAN1 specification.**Answer 3 for R1-2200884 (R2-2201960):** RAN1 assumes PDCCH skipping only applies in Active Time and hence DCP cannot be missed due to PDCCH skipping, i.e. approach 3 is preferred.**Answer 4 for R1-2200884 (R2-2201960):** It is RAN1’s understanding that UE should continue transmitting CSI report/SRS during the PDCCH skipping duration. **For proposal 7-5**, if we agree with RAN2 agreement, it should check whether the followings cases (scrambed by C-RNTI) should be avoid to be skipped.* For CFRA 4-step RACH procedure, PDCCH for BFR RAR scrambled by C-RNTI can be in recovery SS (USS),
* For CBRA 4-step RACH procedure, PDCCH for Msg4 scrambled by C-RNTI can be in any SS,
* For CFRA 2-step RACH, PDCCH for RAR scrambled by C-RNTI for HO only,
* For CBRA 2-step RACH, PDCCH for BFR RAR scrambled by C-RNTI can be in any SS

**For proposal 7-6**, some companies (ZTE, Nokia, LGE, Huawei) think the current proposal 7-6 can be a start point or with some clarification/modification. Some companies (Apple, CATT, Nordic) do not support since SR based PDCCH adaptation been discussed in RAN1 for long time without agreement. Qualcomm prefer to capture it in RAN2.To move forward, moderator would like to first check whether companies are OK with the intention from RAN2 LS of the 1st agreement as follows,* UE ignores PDCCH skipping while the SR is pending
 |
| Samsung  | For proposal 7-6: SR is pending is not clear to us. We prefer previous version.  |
| Lenovo | Fine with Proposal 7-1 ~ 7-4 (v2). Ignoring PDCCH skipping after SR transmission and SR pending can be captured in RAN2 spec.  |
| Nokia\_2 | Firstly to note that in my understanding RAN2 has agreed the SR and RACH related behaviour (e.g. skipping is not applied during contention resolution), and wanted just to confirm whether RAN1 has already accounted this and if something has been missed by RAN2. Hence, if we response to RAN2 that e.g. C-RNTI in MsgB window is affected, and that RAN1 accounts the RAN2 agreement in RAN1 spesification, we should also agree the related specification change (the functionality). Thus before agreeing to Answer 2, this should be clarified, covering also the observed C-RNTI cases. **For proposal 7-5**; in short we think that skipping should not be applied for these. The main reason as explained earlier is that we need to be able to ensure that the ‘connection’ is kept for the CONNECTED mode UE. While network can provide power saving opportunities for CONNECTED mode UE e.g. via C-DRX, this should not hinder maintaining the connection.Like noted earlier, if we would agree that PDCCH skipping is cancelled when RACH is triggered (for any reason), we can simplify the specification change and adopt the (also) RAN2 agreements more directly to RAN1 spesification (e.g. SR would need to be covered only in PUCCH, and no need to separate different cases for RACH). |
| Ericsson1 | 7-1 : Regarding moderator intermediate proposal : Answer 1 : Depends on outcome of discussion on proposal 2-1, currently only type-3 CSS and USS sets are affected by PDCCH skipping. Answer 2 : Support. Answer 3 : In general we prefer to avoid linking skipping/not based on whether UE is in active time/not and prefer to keep these independent. We do not see issue with DCI 2\_6 handling as it is up to gNB implementation. However, if majority view is towards moderator proposed answer 3, we prefer to clarify that skipping is only applicable during the active time including cases when skipping duration includes active time slots and DRX slots.Answer 4 : Prefer to make it more clear “transmission of CSI/SRS is not affected by PDCCH skipping i.e. CSI/SRS is still transmitted during the skipping duration.”7-5 : Prefer simpler formulation. Skipping should not be applied for cases where UE transmits SR/RACH, etc. 7-6 : Support.  |
| Huawei, HiSilicon | 1. Regarding “UE ignores PDCCH skipping while the SR is pending”,we agree with it. For the comments of “since SR based PDCCH adaptation been discussed in RAN1 for long time without agreement.”, we think the reason we didn’t make agreement is it was treated with low priority. Furthermore, “SR is pending” is triggered by the arrival of uplink traffic in UE, and gNB can know “SR is pending” on the UE until the reception of the transmitted SR by the UE. In this sense, gNB can cancel the PDCCH skipping after the reception of the SR transmtted by the UE. In this sense, we think the following proposed agreement is a proper way to capture RAN2’s agreement of “UE ignores PDCCH skipping while the SR is pending”.

*- If the UE is indicated skipping PDCCH monitoring for a duration and at the first slot after the last OFDM symbol of a positive SR transmission, the UE stops PDCCH skipping (i.e., PDCCH skipping is not activated ).**2)* Regarding the answer 3 following, it implies that DRX timer shall impact the operation of PDCCH skipping, which would introduce more complexity on UE to handle cross-layer interaction on UE. Therefore, we have concern on it.**Answer 3 for R1-2200884 (R2-2201960):** RAN1 assumes PDCCH skipping only applies in Active Time and hence DCP cannot be missed due to PDCCH skipping, i.e. approach 3 is preferred. |
| Qualcomm2 | As Nokia\_1 commented, it is also our understanding that RAN2’s agreement only focus on CBRA. The main reason is that, with CBRA, the network cannot identify which UE is initiating the RACH procedure, and hence does not know whether PDCCH skipping has been applied for the UE or not – therefore it is reasonable to assume that RA-RNTI/MsgB-RNTI montoring is not affected by PDCCH skipping. For CFRA, the network knows which UE is triggering the RACH procedure, and also knows the PDCCH MOs of the UE, accounting for the PDCCH skipping. Thus the issue is less problematic.From RAN1’s perspective, without distinguishing CBRA and CFRA, it would be beneficial to adopt a unified solution. As Nokia and Mediatek suggested, terminating PDCCH skipping upon triggering RACH would be the unified solution, which is also compatible with RAN2’s agreement. |

# Proposals for further discussion

## For GTW

## Proposal for further discussion

## Other remaining issues

#  Summary of the previous agreements

## RAN1#102-e

Agreements:

* Reusing power model in TR38.840 for evaluation of DCI-based power saving adaptation schemes.
	+ Note: company reporting additional power model for missing state or update is not precluded.

Agreements:

* Company should report assumptions used for periodic measurement activities for the Rel-17 DCI-based power saving adaptation evaluation.
	+ The periodic activities defined in TR38.840 can be reused.
	+ Measurement for RLM/BFD every C-DRX cycle can be optionally modelled

Agreements:

* The performance metrics described in TR38.840 section 8.2 is reused for power saving evaluation of Rel-17 DCI-based power saving adaptation during ActiveTime.
* The following Rel-15 / 16 features is recommended of the power consumption as reference for baseline. Company can report the feature(s) being used in the baseline.
	+ DRX
		- C-DRX cycle 40msec for VoIP
			* 10ms IAT, 8ms On-duration
			* Assume max two packets bundled
		- C-DRX cycle 160msec for FTP
			* Alt 1: 20 msec IAT, 8ms On-duration
			* Alt 2: short DRX
				+ 20 ms [or 40ms as optional] IAT, 8ms On-duration
				+ 20 ms for short DRX cycle, 4 cycles
			* Note: 100 msec IAT, 8ms On-duration can also be used with sufficient justifications that available Rel-15/16 Techniques being used to reduce UE power saving
	+ DCP for DRX adaptation,
		- DCP offset  to DRX ON = 2 ms, other values are not precluded
	+ Cross-slot scheduling adaptation
		- Minimum K0 can be adapted from 0 to 1 for FR1, 0 to [4] for FR2
	+ BWP switching, including
		- MIMO layer adaptation,
			* Max # of MIMO layer can be adapted from 4 layer to 2 layer for FR1, 2 layer to 1 layer for FR2
		- PDCCH monitoring period adaptation
			* PDCCH monitoring period can be adapted from per slot monitoring to X slot monitoring
				+ X = [2] for FR1 and [8] for FR2
		- Bandwidth adaptation
			* Bandwidth can be adapted from 100MHz to 20MHz for FR1,FFS for FR2
		- Note:
			* BWP transition time type 2 is assumed, BWP transition duration is
				+ 5 slot @ 30kHz SCS for FR1,
				+ 18 slot@120kHz SCS for FR2
				+ the slot-average power level for BWP transition duration is according to TR38.840
				+ BWP transition time type 1 can be optional modelled
			* BWP switching is Y (ms) after last packet/data burst.
				+ Y = [8], other values are not precluded
			* Whether BWP switching is modeled depends on the assumed UE capability and evaluated schemes.
	+ Scell dormancy assumption for CA capable UEs
		- FR1 & FR2: SCell dormancy with [160 ms] periodic CSI measurement and reporting
* Other settings
	+ CA assumption if configured for CA capable UEs
		- For FR1, FFS
		- For FR2, 4\*100MHz can be considered.
	+ Assumptions for scheduler
		- For FR1, no restriction on the beam assumptions being used in each slot
		- For FR2, up to each company, e.g., gNB equally schedule the slots for UEs targeting to different beams.
		- Note: the assumptions does not necessary mean to restrict or precluded any implementation. Other assumptions are not precluded and can be reported by companies.
	+ Company to report the used assumption for the interruption and also power savings impact due to presence/absence of interruptions .

Agreements:

Legacy traffic models in TR38.840 can be considered for Rel-17 DCI-based power saving adaptation evaluation, other traffic models can be optionally modelled and company report which traffic model(s) is used.

Draft LS is approved (with generic RAN2 action), with final LS in [R1-2007419](file:///C%3A/Users/wanshic/OneDrive%20-%20Qualcomm/Documents/Standards/3GPP%20Standards/Meeting%20Documents/TSGR1_102/Docs/R1-2007419.zip).

## RAN1#103-e

Agreements:

Observation:

* Each of the following schemes is individually shown to be beneficial for UE power saving compared to the baseline.
	+ Dynamically switching search space set
	+ Dynamically skipping PDCCH monitoring for a certain duration or until next DRX ON
* At least the following Rel-15 and/or Rel-16 power saving solutions have been utilized for baseline,
	+ For eMBB traffic,
		- DRX setting(including using short DRX or long DRX with a short IAT or long IAT), Wake-up signal, Cross-slot scheduling, CA/Scell dormancy, MAC-CE skipping, BWP switching
	+ For VoIP traffic,
		- DRX setting(only long DRX cycle with a short IAT), Wake-up signal,  Cross-slot scheduling, MAC-CE skipping
	+ For IM traffic,
		- DRX setting(long DRX cycle [with a short IAT]), Wake-up signal
	+ For intensive eMBB traffic,
		- DRX setting(including using short DRX or long DRX with a short IAT), Wake-up signal, Cross-slot scheduling, [CA/Scell dormancy], MAC-CE skipping, BWP switching
		- Note: intensive eMBB traffic is optional and companies may use FTP model 3 with different packet size and mean data arrival time, e.g., 15ms, 30ms, 50ms or 100ms.
* Note 1: For Search space switching, switching from 1slot monitoring to 2, 4, 8, 10, 16 or 32 slot with 30kHz SCS (FR1) and 120kHz (FR2) is utilized.
* Note 2: For PDCCH skipping , skipping 2ms, 4ms, 5ms, 8ms, 15ms, 16ms, 32ms,  64ms or to next DRX cycle is utilized
* Note 3: the baseline assumed may vary across companies

Agreements:

* **Specify at least one of the following options for Rel-17 dynamic PDCCH adaptation ~~in time-domain~~ for active time,**
	+ **Option 1: Search space set group switching,e.g., ~~potential adjustments/enhancements for~~including explicit and implicit search spaceset group switching ~~specified in R16 for NR-U~~**
	+ **Option 2: PDCCH skipping for a certain duration / DRX cycle**
* **FFS: which option(s)~~(e.g. taking into account additional gain of option 1 over option 2, or vice-versa)~~**
* **Candidate DCI formats for dynamic PDCCH adaptation include DCI formats 1\_1(including scheduling and non-scheduling DCI), 0\_1, 1\_2, 0\_2, 2\_0, 2\_6.**
* **Note:**
	+ **Companies are encouraged to provide analysis on specification impact, power saving benefit and system impact (e.g., packet latency, system overhead)**
* **FFS: other schemes are not precluded for further study**

## RAN1#104-e

Agreements:

* Strive for a common design for DCI based PDCCH monitoring adaptation in active time for an active BWP to support functionalities inclusive of both SSSG switching and PDCCH skipping for a duration.
	+ Details FFS

Agreements:

* Further study whether and how to minimize the impact to data scheduling for new transmissions and retransmissions.
	+ FFS details
* Further study the application delay for PDCCH adaptation indication

Agreements:

For DCI based PDCCH skipping in active time for an active BWP (if supported), the following can be further considered,

* Explicit indication of PDCCH adaptation
	+ Scheduling DCI
		- Format 1\_1
		- Format 0\_1
		- Format 0\_2/1\_2
	+ Non-scheduling DCI
		- Format 2\_6 in active time
		- Format 2\_0
		- Format 1\_1 (SCell dormancy case 2)
	+ additional indication mechanism
		- By reusing Rel-16 SCell dormancy indication when CA is configured, FFS details
		- By reusing Rel-16 cross-slot scheduling indication when R16 cross-slot scheduling is configured, FFS detailds
* DCI dynamically indicates a duration/periodic interval for skipping
	+ FFS: how to indicate the duration/period interval, e.g., number of slots or skipping current DRX
* PDCCH skipping for a duration indicated by minimum scheduling offset
* Others are not precluded

Agreements

* For DCI based SSSG switching in active time for an active BWP (if supported), the following can be further considered,
	+ Explicit indication of PDCCH adaptation
		- Scheduling DCI based
			* Format 1\_1,
			* Format 0\_1,
			* Format 0\_2/1\_2
			* ~~Format 1\_0~~
		- Non-scheduling DCI ~~supported by vivo, Samsung~~
			* Format 2\_6 in active time
			* Format 2\_0
			* ~~Format 1\_0~~
			* Format 1\_1 (SCell dormancy case 2)
		- additional indication mechanism
			* By reusing Rel-16 SCell dormancy indication when CA is configured, FFS details
			* By associating Rel-16 cross-slot scheduling indication when R16 cross-slot scheduling is configured, FFS detailds
		- DCI dynamically indicates a duration ~~period~~ for the switched SSSG, UE switch back to previous/default SSSG after duration ends~~timer expried~~
	+ Timer-based SSSG switching, including RRC configured a timer, UE switch back after timer expired.
	+ SSSG activation/deactivation
	+ FFS: Implicit SSSG switching
		- SSSG switching triggered by SR
		- SSSG switching triggered by RACH
		- Default SSSG that a UE monitors when coming out of DRX to monitor an ON duration.
* FFS: whether/how to support SSSG switching for multiple groups of cell(s).
* FFS: whether/how to support SSSG switching in active time with DCP outside active time
* FFS: whether / how to support more than 2 SSSGs,
	+ FFS: number of SSSGs
* FFS: a search space set group to emulate PDCCH skipping
* Others are not precluded

Agreements:

* The following alternatives can be considered for DCI based PDCCH monitoring adaptation in active time for an active BWP for power saving
	+ Alt 1: Enhancement of Rel-16 SSSG switching to support PDCCH monitoring adaptation including skipping for a duration
	+ Alt 2a: Enhancement of DCI(s) utilized for Rel-16 power saving adaptation for supporting both skipping PDCCH monitoring for a duration and SSSG switching
	+ ~~Alt 2b: Enhancement of DCI(s) utilized for Rel-16 power saving adaptation for supporting both skipping PDCCH monitoring for a duration and PDCCH monitoring periodicity adaptation~~
	+ Others not precluded

## RAN1#105-e

Agreement:

* PDCCH schedules data and also indicates PDCCH monitoring adaptation by SSSG switching and PDCCH skipping for a duration is supported.
	+ At least DCI format(s) 1-1, 0-1, 1-2 and 0-2 can be used for the indication(s)

Agreement:

* ~~At least~~ one of  Alt 1 and Alt 2 is supported, to be decided in RAN1#106,
* Alt 1: Supporting SSSG  switching to emulate PDCCH skipping functionality,
	+ Alt 1-1: by an ‘empty’ SSSG which no SS set(s) is configured for the ‘empty’ SSSG, UE does not monitoring PDCCH on the ‘empty’  SSSG,
	+ Alt1-2: by a ‘dormant SSSG’ which may have associated SS sets, and monitored conditionally (e.g., depending on HARQ NACK or RTT/ReTx timers)
* Alt 2: PDCCH schedules data and also indicates PDCCH monitoring adaptation by PDCCH skipping for a duration is supported.
	+ FFS details, including
		- e.g., joint / separate indication of SSSG switching and PDCCH skipping
		- Determination of the duration(s) for PDCCH skipping, e.g.,
			* by RRC signaling,
			* by DCI indication
			* Implicitly, to the end of C-DRX active time

Agreement:

At least SSSG#0 and SSSG#1 switching is supported for Rel-17 SSSG switching indicated by PDCCH scheduling data and/or timer.

* FFS: support of more than 2 SSSGs

## RAN1#106-e

Agreement

* At most 2 bit indication in self-scheduling DCIs (i.e., DCI format 1-1/0-1/1-2/0-2) can be specified for triggering the PDCCH monitoring adaptation in a single cell
	+ FFS: the bit size of the indication is configurable
	+ FFS: bit mapping to the PDCCH monitoring behaviour
	+ FFS: details of indication of multiple cells case

Agreement

Select either package 1 or package 2

Package 1

·       UE behavior after receiving PDCCH indication of monitoring adaptation can be one of the followings,

* + - Working Assumption: Beh 1: PDCCH skipping is not activated
		- Beh 1A: PDCCH skipping means stopping PDCCH monitoring for a duration X
			* FFS the possible values for X
			* FFS: Whether and how to support more than one skipping duration(s)
			* FFS: whether to continue monitoring PDCCH scrambled by C-RNTI for Type 0/1/1A/2 CSS or not
		- Beh 2: stop monitoring SS sets associated with SSSG#1 and SSSG#2 (if confirmed and configured) and monitoring  of SS sets associated to SSSG#0 (legacy behaviour)
		- Beh 2A: stop monitoring SS sets associated with SSSG#0 and SSSG#2 (if confirmed)  and monitoring  of SS sets associated to SSSG#1 (legacy behaviour)
		- Working Assumption: Beh 2B(if confirmed): stop monitoring SS sets associated with SSSG#0 and SSSG#1 and monitoring  of SS sets associated to SSSG#2 (if confirmed)

·       Note: The number of supported SSSG is left to UE feature discussion.

·       FFS: UE capability of supported UE behaviors

·       Indication of Beh 1A when SSSG(s) are not configured is supported.

·       Working assumption: Indication of Beh 1A for current SSSG when two SSSG(s) are configured is supported

·       FFS: Indication of Beh 1A when three SSSG(s) (if supported) are configured

·       Y bits is configured for scheduling DCIs (i.e., DCI format 1-1/0-1/1-2/0-2) indicating PDCCH schedules data and also PDCCH monitoring adaptation

* + - FFS how the UE behavior(s) defined above mapping to Y bits

§  Note: at most Y = 2

·       Working Assumption at most 3 SSSGs is supported to be configured.

* + - FFS: whether or how SSSG can be configured to be monitored conditionally (e.g., depending on HARQ NACK or RTT/ReTx timers)
		- FFS: whether or how non-default SSSG to another non-default SSSG

·       FFS details of timer(s) for switching between SSSG(s)

* + - UE fallbacks to default SSSG (i.e., SSSG#0) after timer expiration.
		- R16 timer for SSSG switching and the corresponding behavior is as baseline

·       FFS whether the timer(s) is configured per SSSG, ~~or~~per BWP or other approaches.

·       FFS whether the skipping duration(s) is configured per SSSG, per BWP, or other approaches.

·       FFS PDCCH monitoring adaptation indicated by non-scheduling DCI

·       PDCCH based monitoring adaptation is ~~limited~~applied to USS and type-3 CSS.

Package 2 (Alt 1 and Alt 2)

* If alt 1 is supported,
	+ supporting SSSG  switching to emulate PDCCH skipping functionality by an ‘empty’ SSSG (i.e. Alt 1-1)or ‘dormant’ SSSG(i.e. Alt 1-2)
		- Y bits is configured for scheduling DCIs (i.e., DCI format 1-1/0-1/1-2/0-2) indicating SSSG index.
			* FFS dynamic indication of ~~initial~~ timer value(s)
			* FFS details
		- At most [3] SSSGs is supported to be configured.
			* Note: including‘empty’ SSSG or ‘dormant’ SSSG
		- ~~FFS support of single timer to switch to default SSSG#0  or support of multiple timers between SSSGs~~
		- FFS whether one or more of the following timer(s) is supported for switching between
			* Option 1: Non-default SSSG to default SSSG (i.e., SSSG#0)
			* Option 2: Non-default SSSG to another non-default SSSG
			* Option 3: Default SSSG (i.e., SSSG#0) to non-default SSSG(s)
		- FFS: down selection between ‘empty’ SSSG (i.e. Alt 1-1)or ‘dormant’ SSSG(i.e. Alt 1-2)
		- ~~FFS: whether ‘empty’ SSSG and ‘dormant’ SSSG, can be looked as a skipping duration and whether to introduce a SSSG state.~~
		- FFS: whether the timer is configured per SSSG, per BWP, or other approaches.
		- ~~FFS: whether multiple timer duration(s) can be configured by RRC, and DCI dynamically indicates a timer duration~~
		- ~~FFS: do we need to define default SSSGs and for what purpose?~~
		- Note: description of ‘empty’ SSSG and ‘dormant’ SSSG has been provided in RAN1#105-E
* If alt 2 is supported,
	+ PDCCH schedules data and also indicates PDCCH monitoring adaptation by PDCCH skipping for a duration is supported.
		- Y bits is configured for scheduling DCIs (i.e., DCI format 1-1/0-1/1-2/0-2) indicating PDCCH monitoring adaptation ~~(including  SSSG index, and/or PDCCH skipping duration(s))~~
			* ~~Alt 2-1:~~
				+ FFS: Determination of the duration for PDCCH skipping, e.g.,

One skipping duration configured by RRC signaling,

Multiple candidate values of skipping duration configured by RRC signaling and use DCI to dynamically indicate one of the configured skipping duration

by specification

* + - * + FFS: possible value(s) of the duration
				+ FFS: joint or separate indication with SSSG switching
			* ~~Alt 2-3:~~
				+ FFS: whether introduce SSS/SSSG specific skipping indication via e.g. bitmap, codepoint, joint indication with a minimum scheduling offset value
		- FFS: whether the skipping duration is configured per SSSG, per BWP, or other approaches.
		- FFS: PDCCH skipping indicated by non-scheduling DCI
		- FFS: interaction with SSSG switching (when configured), e.g. impact to skipping when SSSG timer expires, which SSSG after PDCCH skipping is monitored, etc.

Agreement

Package 1 in above agreement is selected.

## RAN1#106bis-e

**Agreement**

**Confirm the four working assumptions(extracted from package 1)**

Working assumption(extracted from package 1):

Beh 1: PDCCH skipping is not activated

Working assumption(extracted from package 1):

Indication of Beh 1A for current SSSG when two SSSG(s) are configured is supported

Working assumption(extracted from package 1):

At most 3 SSSGs is supported to be configured for PDCCH monitoring adaptation.

Working assumption(extracted from package 1):

Beh 2B: stop monitoring SS sets associated with SSSG#0 and SSSG#1 and monitoring of SS sets associated to SSSG#2.

**Agreement**

Scheduling DCIs indicating timer value for a SSSG is not supported.

**Agreement**

For Beh 1A,

* + The UE can be configured to be indicated by DCI a value of X ~~slots~~ (i.e., skipping duration) among ~~up to~~ *~~M~~**~~= {1, 2, 3}~~*multipleRRC configured values by scheduling DCIs indicating PDCCH schedules data
		- The bits for indicating PDCCH monitoring adaptation also indicating skipping duration. Details FFS
		- ~~The maximum value of~~ *~~M~~* ~~= [2 or 3]~~
		- ~~Note: M = 1 is not precluded.~~

**Agreement**

The bit mapping of DCI indication PDCCH monitoring adaptation is as follows,

* For Case 1 (i.e., PDCCH skipping), the following is supported
	+ 1-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors if *M*=1
		- ‘0’ is Beh 1 and ‘1’ is Beh 1A
	+ 2-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors if *M*=2 or 3
		- ‘00’ is Beh 1
		- ‘01’ is Beh 1A with skipping duration 1
		- ‘10’ is Beh 1A with skipping duration 2
		- ‘11’ is Beh 1A with skipping duration 3 if M=3, reserved if M=2
* For Case 2  (i.e., 2 SSSG switching) , the following is supported
	+ 1-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors
		- ‘0’ is Beh 2 and ‘1’ is Beh 2A
* For Case 3 (i.e., 3 SSSG switching) , the following is supported
	+ 2-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors
		- ‘00’ is Beh 2
		- ‘01’ is Beh 2A
		- ‘10’ is Beh 2B
		- [‘11’ is reserved]
			* ~~FFS ‘11’ is Beh 1A~~
* For Case 4 (i.e., 2 SSSG switching with PDCCH skipping) , the following is supported
	+ 2-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors,
		- ~~Indicated UE behaviors are Beh 1A, 2, 2A and FFS whether indicate Beh 1~~
		- FFS details bit mapping
		- ~~FFS Timer behavior (e.g., reset timer value) for PDCCH monitoring adaptation indication when Beh 1A is indicated~~
* FFS: For Case 5 (i.e., 3 SSSG switching and skipping)
	+ 2-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors
		- ‘00’ is Beh 2
		- ‘01’ is Beh 2A
		- ‘10’ is Beh 2B
		- ‘11’ is Beh 1A
	+ FFS Timer behavior ~~(e.g., reset timer value) for PDCCH monitoring adaptation indication~~ when Beh 1A is indicated
* Note: The UE can be configured to be indicated by DCI a value of X ~~slots~~ (i.e., skipping duration) among *M* RRC configured values by scheduling DCIs indicating PDCCH schedules data
* FFS whether to restrict Skipping duration to be shorter than SSSG initial timer value
* FFS whether the configuration is same or different for DCI format x\_1 and DCI format x\_2

**Agreement (email approval)**

-         The value of the SSSG switching timer in slots for ~~monitoring PDCCH in the active DL BWP of the serving cell~~ SSSG#1 and/or SSSG#2 ~~before moving to the default search space group is~~ can be configured as

o    {[1...20,40,60,80,100]} for 15 kHz SCS,

o    {[1...40, 80,100,160,200]} for 30 kHz SCS,

o    {[1...80, 160,200,320,400]} for 60kHz SCS,

o    {[1...160,320,400,640,800]} for 120kHz SCS

**Agreement (email approval)**

-         If the UE monitors PDCCH according to SSSG#1 and the timer expires, the UE starts monitoring PDCCH according to Beh 2.

~~-~~If the UE monitors PDCCH according to SSSG#2 and the timer expires,

o    Alt 1: the UE monitoring PDCCH according to Beh 2

o    Other alternatives are not precluded

-         Timer can be optionally configured.

**Agreement (email approval)**

**Select one of the alternatives from the following:**

-         Alt 1: Separate RRC configuration for timer value(s) is supported for switching from SSSG#2 to SSSG#0 and from SSSG#1 to SSSG#0 respectively.

-         Alt 2: the timer value(s) for switching from SSSG#2 to SSSG#0 and from SSSG#1 to SSSG#0 is common and configured per cell.

-         Alt 3: the timer value(s) for switching from SSSG#2 to SSSG#0 and from SSSG#1 to SSSG#0 is common and configured per BWP.

**Agreement (email approval)**

The following application delay for a scheduling DCI based PDCCH monitoring adaptation indication can be considered~~is as follows~~,

-         For PDCCH skipping,

o    Option b

o    Option f

o    Option d for downlink grant and Option c for uplink grant

o    Option i

o    Option j

o    Note: down-select ~~between~~ based on the options in RAN1#107-E

-         For SSSG switching,

o    Option a

o    Option d for downlink grant  and Option c for uplink grant

o    Option h

o    Option b

o    Option d for downlink grant and Option g for uplink grant

o    Note: down-select ~~between~~ based on the options in RAN1#107-E

-         The Options a – j is defined as follows,

o    Option a: the application timelines provided in Table 10.4-1 in TS38.213 for search-space group switching for unlicensed band form is reused.

       for SCS configuration , FFS X = 25 or 39

      FFS:

o    Option b:  the application delay needed for PDCCH processing for Rel-16 minimum application delay for K0min/K2min indication is reused/extended.

o    Option c: PDCCH monitoring adaptation command applies after PUSCH transmission if triggered by UL DCI

o    Option d: PDCCH monitoring adaptation command applies after HARQ-ACK transmission (or plus some margin for HARQ-ACK decoding).

o    Option e: after successfully decoding TB.

o    Option f:  Application delay should be “ZERO”  for PDCCH monitoring adaptation. PDCCH monitoring adaptation would be applied after UE receive the additional PDCCH monitoring adaptation control signaling bit(s) in DCI

o    Option g:  Application delay(s) are configured via RRC signaling

o    Option h:  Application delay applies after drx-RetransmissionTimerUL expires

o    Option i: Leave up to implementation

o    Option j: UE applies the skipping immediately (e.g. next symbol/slot) after the UE receives the indication in DL assignment. If the UE fails to decode the associated PDSCH and transmits a NACK, skipping is canceled in the slots after the NACK transmission. Option g ( application delay configured via RRC signaling) is used for uplink grant. If RRC signaling is not provided, UE applies the skipping immediately (e.g. next symbol/slot) after the UE receives the indication in UL grant.

o    Other options not precluded.

-         FFS reference points for the application delay,

~~o        e.g., the PDCCH monitoring indication applies at a first slot that is at least  symbols after the last symbol of the PDCCH, where T is defined as application delay~~

-         FFS whether the same or different and how application delay for PDCCH monitoring adaptation indicated by DCI and timer expiration

-         FFS non-scheduling DCI if supported

## RAN1#107-e

Agreement

The following agreement in RAN1#106-E is updated as follows,

Agreement(extracted from RAN1#106-E)

* At most 2 bit indication in self-scheduling DCIs (i.e., DCI format 1-1/0-1/1-2/0-2) can be specified for triggering the PDCCH monitoring adaptation in a single cell
	+ FFS: the bit size of the indication is configurable
	+ FFS: bit mapping to the PDCCH monitoring behaviour
	+ FFS: details of indication of multiple cells case
	+ A new indication field in scheduling DCI is used for indicating PDCCH monitoring adaptation

Agreement

Confirm the working assumptions with the following updates (extract from RAN1#106-bis agreements)

* The value of the timer in slots for monitoring PDCCH in the active DL BWP of the serving cell before moving to the default search space group is
* {1,2,3,…,20,30, 40, 50, 60, 80, 100} for 15 kHz SCS,
* {1,2,3,…,40, 60, 80, 100, 100,160,200} for 30 kHz SCS,
* {1,2,3,…,80, 120, 160, 200, 240, 320,400} for 60kHz SCS,
* {1,2,3,…,160, 240, 320,400, 480, 640,800} for 120kHz SCS

Agreement

* For Case 4 (i.e., 2 SSSG switching with PDCCH skipping) , one of the following is supported
	+ Alt a: 2-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors
		- If *M* = 1, then
			* ‘00’ is Beh 2
			* ‘01’ is Beh 2A
			* ‘10’ is Beh 1A ~~(stay in current SSSG)~~
			* ~~[~~‘11’ is reserved~~]~~
		- If *M* = 2, then
			* ‘00’ is Beh 2
			* ‘01’ is Beh 2A
			* ‘10’ is Beh 1A for duration T1  ~~(stay in current SSSG)~~
			* ‘11’ is Beh 1A for duration T2 ~~(stay in current SSSG)~~
* Note: for ‘00’ and ‘01’, UE performs Beh 1(i.e., does not perform PDCCH skipping )
* Note: By a single DCI indication, a UE is not expected to simultaneously perform two behaviors of SSSG switching and PDCCH skipping.
* FFS SSSG switching timer behavior, and timer value related to the value of T1/T2

Agreement

If a UE is provided with a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE

-            resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot

o    Alt 2a: for the Type3-PDCCH CSS set or the USS set with group index of either 1 or 2

o    Alt 2b: for the Type3-PDCCH CSS set or the USS set

o    Alt 2c: with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI

-            otherwise, decrease the timer value by one after each slot.

-            FFS: When the timer expires in a slot

Agreement

-            For value X in Beh 1A, candidate skipping values are

o    Up to [100ms] length is supported,

o    The X is configured and indicated in the unit of slot.

o    Working assumption for candidate values for X

o    {1,2,3,…,20,30, 40, 50, 60, 80, 100} for 15 kHz SCS,

o    {1,2,3,…,40, 60, 80, 100, 120,160,200} for 30 kHz SCS,

o    {1,2,3,…,80, 120, 160, 200, 240, 320,400} for 60kHz SCS,

o    {1,2,3,…,160, 240, 320,400, 480, 640,800} for 120kHz SCS

o    FFS: Equal to or longer than the applicable minimum scheduling offset

o    FFS: additional  symbol level / PDCCH monitoring period level skipping duration

## RAN1#107bis-e

Agreement

Remove the bracket from following agreement made in RAN1#106bis-E

Agreement (extracted from RAN1#106bis-E)

* For Case 3 (i.e., 3 SSSG switching) , the following is supported
	+ 2-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors
		- ‘00’ is Beh 2
		- ‘01’ is Beh 2A
		- ‘10’ is Beh 2B
		- ~~[~~‘11’ is reserved~~]~~

Agreement

Confirm the following working assumption (extracted from RAN1#107-bis agreements)

Agreement

* For value X in Beh 1A, candidate skipping values are
	+ Up to [100ms] length is supported,
		- The X is configured and indicated in the unit of slot.
			* Working assumption for candidate values for X
				+ {1,2,3,…,20,30, 40, 50, 60, 80, 100} for 15 kHz SCS,
				+ {1,2,3,…,40, 60, 80, 100, 120,160,200} for 30 kHz SCS,
				+ {1,2,3,…,80, 120, 160, 200, 240, 320,400} for 60kHz SCS,
				+ {1,2,3,…,160, 240, 320,400, 480, 640,800} for 120kHz SCS
	+ FFS: Equal to or longer than the applicable minimum scheduling offset
	+ FFS: additional symbol level / PDCCH monitoring period level skipping duration

Agreement

* The initial timer value for switching from SSSG#2 to SSSG#0 and from SSSG#1 to SSSG#0 is common and configured per BWP.
* The *PDCCHSkippingDurationList-r17* is configured per BWP.

Working Assumption

* The bit length of the candidate skipping values and SSSG switching initial timer values in slots for 480kHz and 960kHz SCS are assumed to be the same as that for 120KHz SCS

Agreement

PDCCH monitoring adaptation is only applied to the individual scheduling cell (including self-scheduling and cross-carrier scheduling)

Conclusion

For Rel-17 PDCCH monitoring adaptation, the case where single DCI indicates monitoring adaptation for multiple cells is not supported.

Agreement

For PDCCH monitoring adaptation case 1, support at most M = 3 for PDCCH skipping with 2 bits indication.

Agreement

The configuration of PDCCH monitoring adaptation is common for DCI format x-1 and x-2*,* neither Alt 1 nor Alt 2 is agreed,

* Alt 1: Support RRC parameter configured for the PDCCH monitoring adaptation indication field presence/absence in DCI format x-2.
* Alt 2:  The configuration of PDCCH monitoring adaptation is common for DCI format x-1 and x-2, except skipping duration for DCI format x-2 (i.e., *PDCCHSkippingDurationList-r17-x-2* for DCI format x-2). The PDCCH monitoring adaptation indication field for DCI format x-2 is dependent on *PDCCHSkippingDurationList-r17-x-2* if configured.

Conclusion

No consensus to introduce non-scheduling DCI based PDCCH monitoring adaptation for Rel-17.

# Proposals from companies’ submitted contributions

## Contributions from AI 8.7.2

## Huawei, HiSilicon

1. **R1-2200946 Remaining issues on the extensions to Rel-16 DCI-based power saving adaptation for an active BWP Huawei, HiSilicon**

***Observation 1: If PDCCH skipping/SSSG switching and BWP switching are indicated simultaneously by the same scheduling DCI, the DCI indicates the PDCCH monitoring adaptation to be applied in the target BWP, which is the same as R15 rule*** ***in cross-BWP scheduling. No special specification change is needed.***

It is proposed that

***Proposal 1: Do not introduce empty SSSG during CR phase, which is a duplicate functionality of PDCCH skipping.***

***Proposal 2: Adopt the Text Proposal 1 to*** ***clarify how to determine 1 bit or 2 bit for Case 2 and Case 3.***

|  |
| --- |
| --------------------------------- Start of Text Proposal 1 for TS 38.212----------------------------------< Unchanged parts are omitted >7.3.1.1.2 Format 0\_1< Unchanged parts are omitted >- PDCCH monitoring adaptation indication – 0, 1 or 2 bits- 1 or 2 bits, if *searchSpaceGroupIdList-r17* is not configured and if *PDCCHSkippingDurationList* is configured- 1 bit if the UE is configured with only one duration by *PDCCHSkippingDurationList;*- 2 bits if the UE is configured with more than one duration by *PDCCHSkippingDurationList*.- 1 or 2 bits, if *PDCCHSkippingDurationList* is not configured and if *searchSpaceGroupIdList-r17* is configured- 1 bit if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0 and search space set(s) with group index 1, and if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;- 2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0, search space set(s) with group index 1 and search space set(s) with group index 2;- 2 bits, if *PDCCHSkippingDurationList* is configured and if *searchSpaceGroupIdList-r17* is configured- 0 bit, otherwise< Unchanged parts are omitted >7.3.1.1.3 Format 0\_2- PDCCH monitoring adaptation indication – 0, 1 or 2 bits- 1 or 2 bits, if *searchSpaceGroupIdList-r17* is not configured and if *PDCCHSkippingDurationList* is configured- 1 bit if the UE is configured with only one duration by *PDCCHSkippingDurationList;*- 2 bits if the UE is configured with more than one duration by *PDCCHSkippingDurationList*.- 1 or 2 bits, if *PDCCHSkippingDurationList* is not configured and if *searchSpaceGroupIdList-r17* is configured- 1 bit if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0 and search space set(s) with group index 1, and if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;- 2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0, search space set(s) with group index 1 and search space set(s) with group index 2;- 2 bits, if *PDCCHSkippingDurationList* is configured and if *searchSpaceGroupIdList-r17* is configured- 0 bit, otherwise< Unchanged parts are omitted >7.3.1.2.2 Format 1\_1- PDCCH monitoring adaptation indication – 0, 1 or 2 bits- 1 or 2 bits, if *searchSpaceGroupIdList-r17* is not configured and if *PDCCHSkippingDurationList* is configured- 1 bit if the UE is configured with only one duration by *PDCCHSkippingDurationList;*- 2 bits if the UE is configured with more than one duration by *PDCCHSkippingDurationList*.- 1 or 2 bits, if *PDCCHSkippingDurationList* is not configured and if *searchSpaceGroupIdList-r17* is configured- 1 bit if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0 and search space set(s) with group index 1, and if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;- 2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0, search space set(s) with group index 1 and search space set(s) with group index 2;- 2 bits, if *PDCCHSkippingDurationList* is configured and if *searchSpaceGroupIdList-r17* is configured- 0 bit, otherwise< Unchanged parts are omitted >7.3.1.2.3 Format 1\_2- PDCCH monitoring adaptation indication – 0, 1 or 2 bits- 1 or 2 bits, if *searchSpaceGroupIdList-r17* is not configured and if *PDCCHSkippingDurationList* is configured- 1 bit if the UE is configured with only one duration by *PDCCHSkippingDurationList;*- 2 bits if the UE is configured with more than one duration by *PDCCHSkippingDurationList*.- 1 or 2 bits, if *PDCCHSkippingDurationList* is not configured and if *searchSpaceGroupIdList-r17* is configured- 1 bit if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0 and search space set(s) with group index 1, and if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;- 2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0, search space set(s) with group index 1 and search space set(s) with group index 2;- 2 bits, if *PDCCHSkippingDurationList* is configured and if *searchSpaceGroupIdList-r17* is configured- 0 bit, otherwise< Unchanged parts are omitted >----------------------------------- End of Text Proposal 1 for TS 38.212-------------------------------- |

***Proposal 3: Do not monitor DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by the C-RNTI, MCS-C-RNTI, or the CS-RNTI in Type0/0A/1 or 2 PDCCH CSS during the PDCCH skipping duration.***

|  |
| --- |
| ------------------------------------------ Start of Text Proposal 2 for TS 38.213-------------------------< Unchanged parts are omitted >10.1 UE procedure for determining physical downlink control channel assignment < Unchanged parts are omitted >If a UE is provided - one or more search space sets by corresponding one or more of *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *ra-SearchSpace*, and - a C-RNTI, an MCS-C-RNTI, or a CS-RNTIthe UE monitors PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in the one or more search space sets in a slot where the UE monitors PDCCH candidates for at least a DCI format 0\_0 or a DCI format 1\_0 with CRC scrambled by SI-RNTI, RA-RNTI, MsgB-RNTI, or P-RNTI, when the UE is not provided *PDCCHSkippingDurationList*, or when the UE is provided *PDCCHSkippingDurationList* and has not been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot.< Unchanged parts are omitted >10.4 Search space set group switching and skipping of PDCCH monitoring< Unchanged parts are omitted >A UE can be provided a set of durations by *PDCCHSkippingDurationList* for PDCCH monitoring on a serving cell and, if the UE is not provided *searchSpaceGroupIdList-r17*, a DCI format 0\_1, and/or DCI format 1\_1, and/or DCI format 0\_2, and/or DCI format 1\_2 that schedules a PUSCH transmission or a PDSCH reception can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits. If the field has 1 bit and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '0' value for the bit indicates no skipping in PDCCH monitoring- a '1' value for the bit indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durationsIf the field has 2 bits and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on a serving cell- a '00' value for the bits indicates no skipping in PDCCH monitoring - a '01' value for the bits indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations- a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the second value in the set of durations- a '11' value for the bits indicates skipping PDCCH monitoring for a duration provided by the third value in the set of durations, if any; otherwise, if the set of durations includes two values, a use of the '11' value is reservedWhen the UE is indicated skipping PDCCH monitoring for a duration on a serving cell, the UE skips monitoring of PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in the one or more search space sets by corresponding one or more of *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *ra-SearchSpace*, in the duration on the serving cell.< Unchanged parts are omitted >A UE can be provided a set of durations by *PDCCHSkippingDurationList* and group indexes for a Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList-r17* for PDCCH monitoring on a serving cell and, a DCI format 0\_1, and/or DCI format 1\_1, and/or DCI format 0\_2, and/or DCI format 1\_2 that schedules a PUSCH transmission or a PDSCH reception can include a PDCCH monitoring adaptation field of 2 bits. If the set of durations includes one value and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '00' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with group index 1, if any- a '01' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with group index 0, if any- a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the value in the set of durations- a '11' value is reservedIf the set of durations includes two values and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '00' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with group index 1, if any- a '01' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with group index 0, if any- a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations- a '11' value for the bits indicates skipping PDCCH monitoring for a duration provided by the second value in the set of durationsWhen the UE is indicated skipping PDCCH monitoring for a duration on a serving cell, the UE skips monitoring of PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in the one or more search space sets by corresponding one or more of *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *ra-SearchSpace*, in the duration on the serving cell.< Unchanged parts are omitted >----------------------------------------- End of Text Proposal 2 for TS 38.213-------------------------- |

***Proposal 4: Endorse the Text Proposal 3 for TS 38.213 regarding how to restart and decrease the timer.***

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| ----------------------------------- Start of Text Proposal 3 for TS 38.213--------------------------------< Unchanged parts are omitted >10.4 Search space set group switching and skipping of PDCCH monitoring< Unchanged parts are omitted >If a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE~~- decrements the timer after a slot of an active DL BWP of the serving cell when the UE does not detect a DCI format in a PDCCH reception in the slot for TBD~~- resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format with CRC scrambled by C-RNTI, CS-RNTI or MCS-C-RNTI in a PDCCH reception in the slot for the Type3-PDCCH CSS set(s) or the USS set(s) with group index of either 1 or 2.- Otherwise, decrements the timer value by one after each slot.< Unchanged parts are omitted >----------------------------------- End of Text Proposal 3 for TS 38.213-------------------------------- |

***Proposal 5: Adopt the text proposal 4 to capture that PDCCH skipping is not impacted by the expiration of SSSG timer, i.e. Alt.1b.***

* ***The part in square brackets highlighted in purple may or may not be needed depending on the outcome of application delay discussion.***

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| --------------------------------- Start of Text Proposal 4 for TS 38.213----------------------------------< Unchanged parts are omitted >10.4 Search space set group switching and skipping of PDCCH monitoring< Unchanged parts are omitted >If a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE- decrements the timer after a slot of an active DL BWP of the serving cell when the UE does not detect a DCI format in a PDCCH reception in the slot for TBD- resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot for TBDWhen the timer expires in slot n,- If the UE has not been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot n+1[+ an application delay of timer based SSSG switching], the UE starts to monitor~~s~~ PDCCH on the serving cell according to search space sets with group index 0 in slot n+1[+ an application delay of timer based SSSG switching];- If the UE has been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot n[+ an application delay of timer based SSSG switching], the UE starts to monitor PDCCH after the completion of the PDCCH skipping for the duration on the serving cell according to search space sets with group index 0.< Unchanged parts are omitted >----------------------------------- End of Text Proposal 4 for TS 38.213-------------------------------- |

***Proposal 6: Support different application delay for SSSG switching and PDCCH skipping：***

* ***For DCI triggered SSSG switching, Alt 1c is adopted, i.e., UE applies the SSSG switching after HARQ-ACK feedback if the DCI is a DL scheduling DCI format, or after the scheduled PUSCH transmission if the DCI is a UL scheduling DCI format;***
* ***For PDCCH skipping, Alt 1b is adopted, i.e., the application delay is max (applicable K0min, Z), after which the UE starts to stop monitoring PDCCH in a duration.***
* ***For timer based SSSG switching, the UE starts monitoring PDCCH according to search space sets with SSSG index 0 at the first slot that is at least Pswitch symbols after a slot where the timer expires.***

***Proposal 7: Adopt the Text Proposal 5 for the application delay of PDCCH monitoring adaptation.***

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| ---------------------------------- Start of Text Proposal 5 for TS 38.213---------------------------------< Unchanged parts are omitted >10.4 Search space set group switching and skipping of PDCCH monitoring< Unchanged parts are omitted >A UE can be provided a set of durations by *PDCCHSkippingDurationList* for PDCCH monitoring on a serving cell and, if the UE is not provided *searchSpaceGroupIdList-r17*, a DCI format 0\_1, and/or DCI format 1\_1, and/or DCI format 0\_2, and/or DCI format 1\_2 that schedules a PUSCH transmission or a PDSCH reception can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits in slot n. If the field has 1 bit and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '0' value for the bit indicates no skipping in PDCCH monitoring- a '1' value for the bit indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations from the slot n+max(*K*0minOld, *Zµ*) , where *K*0minOld is the currently applied *K*0min value of the active DL BWP in the scheduled cell if *minimumSchedulingOffsetK0* is configured for the active DL BWP in the scheduled cell; otherwise, *K*0min is zero. *Zµ* is determined by the subcarrier spacing of the active DL BWP in the scheduling cell in slot *n*, and given in Table 5.3.1-1 in TS 38.214.If the field has 2 bits and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on a serving cell- a '00' value for the bits indicates no skipping in PDCCH monitoring - a '01' value for the bits indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations from the slot n+max(*K*0minOld, *Zµ*) , where *K*0minOld is the currently applied *K*0min value of the active DL BWP in the scheduled cell if *minimumSchedulingOffsetK0* is configured for the active DL BWP in the scheduled cell; otherwise, *K*0min is zero. *Zµ* is determined by the subcarrier spacing of the active DL BWP in the scheduling cell in slot *n*, and given in Table 5.3.1-1 in TS 38.214- a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the second value in the set of durations from the slot n+max(*K*0minOld, *Zµ*) , where *K*0minOld is the currently applied *K*0min value of the active DL BWP in the scheduled cell if *minimumSchedulingOffsetK0* is configured for the active DL BWP in the scheduled cell; otherwise, *K*0min is zero. *Zµ* is determined by the subcarrier spacing of the active DL BWP in the scheduling cell in slot *n*, and given in Table 5.3.1-1 in TS 38.214- a '11' value for the bits indicates skipping PDCCH monitoring for a duration provided by the third value in the set of durations from the slot n+max(*K*0minOld, *Zµ*) , where *K*0minOld is the currently applied *K*0min value of the active DL BWP in the scheduled cell if *minimumSchedulingOffsetK0* is configured for the active DL BWP in the scheduled cell; otherwise, *K*0min is zero. *Zµ* is determined by the subcarrier spacing of the active DL BWP in the scheduling cell in slot *n*, and given in Table 5.3.1-1 in TS 38.214, if any; otherwise, if the set of durations includes two values, a use of the ‘11’ value is reserved.A UE can be provided group indexes for a Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList-r17* for PDCCH monitoring on a serving cell and, if the UE is not provided *PDCCHSkippingDurationList*, DCI format 0\_1, or DCI format 1\_1, or DCI format 0\_2, or DCI format 1\_2 that schedules a PUSCH transmission or a PDSCH reception can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits. If the field has 1 bit and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '0' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, for the serving cell at a first slot after transmitting HARQ-ACK corresponding to the PDSCH scheduled by the PDCCH with the DCI format 1\_1 or DCI format 1\_2, or after transmitting PUSCH scheduled by the PDCCH with the DCI format 0\_1 or DCI format 0\_2- a '1' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, for the serving cell at a first slot after transmitting HARQ-ACK corresponding to the PDSCH scheduled by the PDCCH with the DCI format 1\_1 or DCI format 1\_2, or after transmitting PUSCH scheduled by the PDCCH with the DCI format 0\_1 or DCI format 0\_2If the field has 2 bits and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '00' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, for the serving cell at a first slot after transmitting HARQ-ACK corresponding to the PDSCH scheduled by the PDCCH with the DCI format 1\_1 or DCI format 1\_2, or after transmitting PUSCH scheduled by the PDCCH with the DCI format 0\_1 or DCI format 0\_2- a '01' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, for the serving cell at a first slot after transmitting HARQ-ACK corresponding to the PDSCH scheduled by the PDCCH with the DCI format 1\_1 or DCI format 1\_2, or after transmitting PUSCH scheduled by the PDCCH with the DCI format 0\_1 or DCI format 0\_2- a '10' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 2 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, for the serving cell at a first slot after transmitting HARQ-ACK corresponding to the PDSCH scheduled by the PDCCH with the DCI format 1\_1 or DCI format 1\_2, or after transmitting PUSCH scheduled by the PDCCH with the DCI format 0\_1 or DCI format 0\_2- a '11' value is reservedA UE can be provided a set of durations by *PDCCHSkippingDurationList* and group indexes for a Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList-r17* for PDCCH monitoring on a serving cell and, a DCI format 0\_1, and/or DCI format 1\_1, and/or DCI format 0\_2, and/or DCI format 1\_2 that schedules a PUSCH transmission or a PDSCH reception can include a PDCCH monitoring adaptation field of 2 bits in slot n. If the set of durations includes one value and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '00' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with group index 1, if any, for the serving cell at a first slot after transmitting HARQ-ACK corresponding to the PDSCH scheduled by the PDCCH with the DCI format 1\_1 or DCI format 1\_2, or after transmitting PUSCH scheduled by the PDCCH with the DCI format 0\_1 or DCI format 0\_2- a '01' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with group index 0, if any, for the serving cell at a first slot after transmitting HARQ-ACK corresponding to the PDSCH scheduled by the PDCCH with the DCI format 1\_1 or DCI format 1\_2, or after transmitting PUSCH scheduled by the PDCCH with the DCI format 0\_1 or DCI format 0\_2- a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the value in the set of durations from the slot n+max(*K*0minOld, *Zµ*) , where *K*0minOld is the currently applied *K*0min value of the active DL BWP in the scheduled cell if *minimumSchedulingOffsetK0* is configured for the active DL BWP in the scheduled cell; otherwise, *K*0min is zero. *Zµ* is determined by the subcarrier spacing of the active DL BWP in the scheduling cell in slot *n*, and given in Table 5.3.1-1 in TS 38.214.- a '11' value is reservedIf the set of durations includes two values and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '00' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with group index 1, if any, for the serving cell at a first slot after transmitting HARQ-ACK corresponding to the PDSCH scheduled by the PDCCH with the DCI format 1\_1 or DCI format 1\_2, or after transmitting PUSCH scheduled by the PDCCH with the DCI format 0\_1 or DCI format 0\_2- a '01' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with group index 0, if any, for the serving cell at a first slot after transmitting HARQ-ACK corresponding to the PDSCH scheduled by the PDCCH with the DCI format 1\_1 or DCI format 1\_2, or after transmitting PUSCH scheduled by the PDCCH with the DCI format 0\_1 or DCI format 0\_2- a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations from the slot n+max(*K*0minOld, *Zµ*) , where *K*0minOld is the currently applied *K*0min value of the active DL BWP in the scheduled cell if *minimumSchedulingOffsetK0* is configured for the active DL BWP in the scheduled cell; otherwise, *K*0min is zero. *Zµ* is determined by the subcarrier spacing of the active DL BWP in the scheduling cell in slot *n*, and given in Table 5.3.1-1 in TS 38.214- a '11' value for the bits indicates skipping PDCCH monitoring for a duration provided by the second value in the set of durations from the slot n+max(*K*0minOld, *Zµ*) , where *K*0minOld is the currently applied *K*0min value of the active DL BWP in the scheduled cell if *minimumSchedulingOffsetK0* is configured for the active DL BWP in the scheduled cell; otherwise, *K*0min is zero. *Zµ* is determined by the subcarrier spacing of the active DL BWP in the scheduling cell in slot *n*, and given in Table 5.3.1-1 in TS 38.214.If a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE- decrements the timer after a slot of an active DL BWP of the serving cell when the UE does not detect a DCI format in a PDCCH reception in the slot for TBD- resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot for TBDWhen the timer expires in slot n,- If the UE has not been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot n+1+$\left⌈\frac{P\_{switch}}{14}\right⌉$, the UE starts to monitor~~s~~ PDCCH on the serving cell according to search space sets with group index 0 in slot n+1+$\left⌈\frac{P\_{switch}}{14}\right⌉$;- If the UE has been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot n+1+$\left⌈\frac{P\_{switch}}{14}\right⌉$, the UE starts to monitor PDCCH after the completion of the PDCCH skipping for the duration on the serving cell according to search space sets with group index 0.< Unchanged parts are omitted >-------------------------------- End of Text Proposal 5 for TS 38.213----------------------------------- |

***Proposal 8: After being indicated to skipping PDCCH monitoring, if the HARQ feedback for PDSCH is NACK, the UE still performs PDCCH monitoring for HARQ retransmission when drx-RetransmissionTimerDL is running.***

***Proposal 9: To simplify UE’s implementation,*** ***UE ignores the PDCCH adaptation field in the DCI received during a skipped duration which has been indicated.***

***Proposal 10: Adopt the Text Proposal 6 on the handling of HARQ retransmission.***

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| ---------------------------------- Start of Text Proposal 6 for TS 38.213---------------------------------< Unchanged parts are omitted >10.4 Search space set group switching and skipping of PDCCH monitoring< Unchanged parts are omitted >When the timer expires, the UE monitors PDCCH on the serving cell according to search space sets with group index 0.If a UE is indicated skipping PDCCH monitoring for a duration by a DCI format 1\_1 and/or DCI format 1\_2 that schedules a PDSCH reception, during the indicated duration the UE monitors PDCCH when the *drx-RetransmissionTimerDL* of any HARQ process is running. If a PDCCH monitoring adaptation field is received during an indicated duration for skipping PDCCH monitoring, the indication of PDCCH monitoring adaptation field is ignored by the UE.< Unchanged parts are omitted >-------------------------------- End of Text Proposal 6 for TS 38.213----------------------------------- |

***Proposal 11: If the active BWP is switched due to the expiration of bwp-InactivityTimer before the end of the PDCCH skipping duration, the default behavior on the new active BWP, i.e., default BWP, is***

* ***UE starts monitoring PDCCH according to configured SS sets if SSSG is not configured on the new active BWP;***
* ***UE starts monitoring PDCCH according to SS set in SSSG0 if SSSG is configured on the new active BWP.***

***Proposal 12: In case of a scheduling DCI indicating PDCCH monitoring adaptation and BWP switching simultaneously,***

* ***If PDCCH skipping is indicated, PDCCH skipping duration starts from the slot indicated by the slot offset value of the time domain resource assignment field in the DCI format;***
* ***If SSSG switching is indicated, the indicated SSSG takes effect from the slot indicated by the slot offset value of the time domain resource assignment field in the DCI format.***

***Proposal 13: Support SSSG switching triggered by SR and RACH.***

***Proposal 14: It is up to B52.6 session to decide the detailed values of PDCCH skipping duration and SSSG timer for 480kHz and 960kHz SCS.***

## vivo

1. **R1-2201103 Remaining issues on DCI-based power saving adaptation in connected mode vivo**

**Proposal 1:** Type0/0A/1/2-PDCCH CSS monitoring is not impacted by Rel-17 PDCCH monitoring adaptation

**Proposal 2:**

- If a UE is provided with a timer value by searchSpaceSwitchTimer-r17 for PDCCH monitoring on a serving cell and the timer is running, the UE resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot for the Type3-PDCCH CSS set or the USS set with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI.

- Otherwise, decrease the timer value by one after each slot.

**Proposal 3:** When the timer expires in a slot, UE switches to the default SSSG (SSSG 0) when it receives the indication of PDCCH skipping

**Proposal 4:** Agree the following conclusions and capture it in the TS38.213.

- If PDCCH skipping is activated, PDCCH skipping is not activated (i.e., Beh 1) at the first slot after the last OFDM symbol of the SR transmission.

**Proposal 5:** Agree the following conclusions and capture it in the TS38.213.

If a UE received a DCI format indicating skipping PDCCH monitoring for a duration that overlaps with at least one symbol of a window provided by *ra-ResponseWindow* or *msgB-ResponseWindow* orthe duration where *ra-ContentionResolutionTimer* is running which is controlled by higher layers [11, TS 38.321], the UE skips monitoring PDCCH according to Type3-PDCCH CSS sets or USS sets on the serving cell, except for monitoring a DCI format in response to

- a PRACH transmission, or

- a transmission of a PRACH and a PUSCH, or to a transmission of only a PRACH if the PRACH preamble is mapped to a valid PUSCH occasion, or

- a PUSCH transmission scheduled by a RAR UL grant

**Proposal 6:** the current specification defines the UE behavior for PDCCH skipping and DCP overlap is Approach 2. No additional specification impact is needed.

**Proposal 7:** Agree the following conclusions and capture it in the TS38.213.

If a UE is indicated to skip PDCH for a duration, the UE skips monitoring PDCCH according to Type3-PDCCH CSS sets or USS sets on the serving cell, except for monitoring a DCI format with CRC scrambled by G-RNTI, or G-CS-RNTI, or MCCH-RNTI.

Proposal 8:

For PDCCH monitoring adaptation for SSSG switching,

* Interaction with retransmission by PDCCH monitoring adaptation for SSSG switching is NOT supported.
* down-select one of the following options:
* Alt 1a: the UE applies Beh 1A on the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.
* Alt 1b: the UE applies Beh 1A on the serving cell is applied in the next Zµ slot, where Definition of Zµ is described in Table 5.3.1-1 in TS38.214

For PDCCH monitoring adaptation for PDCCH skipping,

* the UE applies Beh 1A next slot after the last OFDM symbol of ACK transmission/PUSCH transmission, otherwise the indication is not applied.

**Proposal 9: adopt either one of the following text proposals in TS38.212**

For DCI format 0\_1, DCI format 0\_2, DCI format 1\_1 and DCI format 1\_2,

* 1 or 2 bits, if *PDCCHSkippingDurationList* is not configured and if *searchSpaceGroupIdList-r17* is configured
	+ Option A:

-     1 bit if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;

-     2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 2;

* + Option B:

- 1 bit if the UE is configured *numOfSSSG* = 2

- 2 bits if the UE is configured *numOfSSSG* = 3

- Note: *numOfSSSG* is per BWP configured

**Proposal 10: adopt the following text proposals in TS38.213**

When the UE is scheduled with DCI format 0\_1 /1\_1/0\_2/1\_2 with a 'PDCCH monitoring adaptation indication’ field in slot *n*, the UE does not expect to be scheduled 0\_1 /1\_1/0\_2/1\_2 with a 'PDCCH monitoring adaptation indication’ field indicating change to another SSSG or skipping for the same active BWP of the scheduling cell before slot *n+X* of the scheduling cell, where X is the value of the application delay.

## ZTE, Sanechips

1. **R1-2201133 Remaining issues of PDCCH monitoring adaptation during DRX Active Time ZTE, Sanechips**

[Observation 1: If Alt 2a is down-selected, the timer cannot be reset if a DCI indicating SSSG #1 or SSSG #2 is detected in a USS set without SSSG ID, or the DCI configured in SSSG#0.](#_Toc32434)

[Proposal 1: When the timer expires in a slot:](#_Toc27023)

[- If the UE has not been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot, the UE monitors PDCCH on the active BWP of a serving cell according to search space sets with group index 0;](#_Toc8514)

[- If the UE has been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot, the UE starts to monitor PDCCH until the completion of the PDCCH skipping for the duration on the active BWP of a serving cell according to search space sets with group index 0.](#_Toc31525)

[Proposal 2: UE switches to SSSG #0 after the end of PDCCH skipping duration if both PDCCH skipping duration and SSSG are configured.](#_Toc11773)

[Proposal 3: Similar with the legacy mechanism in NR-U, it should be clarified that the start of searchSpaceSwitchTimer-r17 is triggered when UE receives DCI indicating SSSG #1 or SSSG #2 if configured.](#_Toc18846)

[Proposal 4: If a UE is provided with a timer value by searchSpaceSwitchTimer-r17 for PDCCH monitoring on an active BWP of a serving cell and the timer is running, the UE](#_Toc14635)

[- resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot for the Type3-PDCCH CSS set or the USS set.](#_Toc18024)

[- otherwise, decreases the timer value by one after each slot.](#_Toc24951)

[Proposal 5: The candidate SSSG timer value should be longer than the application delay.](#_Toc1187)

[Proposal 6: The candidate skipping values can be configured as](#_Toc18435)

[{20,24,28,32,…,656, 960, 1280,1600,1920,2560,3200} for 480kHz SCS,](#_Toc6505)

[{30,38,46,54,…, 1302,1920,2560,3200,3840,5120,6400} for 960kHz SCS.](#_Toc11281)

[The value of the SSSG switching timer in slots can be configured as,](#_Toc4925)

[{20,24,28,32,…,656, 960, 1280,1600,1920,2560,3200} for 480kHz SCS,](#_Toc9532)

[{30,38,46,54,…, 1302,1920,2560,3200,3840,5120,6400} for 960kHz SCS.](#_Toc27113)

[Proposal 7: Option 3 is used to determine the bit width for case 2/3.](#_Toc30809)

[Proposal 8: When the UE is indicated skipping PDCCH monitoring for a duration on a serving cell, the UE skips monitoring of PDCCH candidates for DCI with CRC scrambled by the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in CSS any CSS and USS.](#_Toc4692)

[Proposal 9: Upon SSSG timer expiration, UE performs Beh 2 at the first slot that is at least P](#_Toc9329)[switch](#_Toc9329)[symbols after a slot where the timer expires](#_Toc9329)

[- Note: P](#_Toc32288)[switch](#_Toc32288)[is defined in Table 10.4-1 in TS38.213, P](#_Toc32288)[switch](#_Toc32288)[for u =3/5/6 is determined in 52.6-71GHz agenda item.](#_Toc32288)

[Proposal 10: If there is no consensus on whether or not an additional UE behavior is needed to handle the case of PDCCH skipping interaction with HARQ retransmission in RAN1 #108-emeeting, the additional UE behavior should not be discussed in later RAN1 meetings.](#_Toc28787)

[Proposal 11: Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating PDCCH skipping (i.e., Beh 1A),](#_Toc18320)

[• UE applies PDCCH skipping on an active BWP of the serving cell at the first slot after the application delay of minimum applicable scheduling offset if a minimum applicable scheduling offset is configured in the BWP,](#_Toc26195)

[• otherwise, UE applies PDCCH skipping on the BWP of the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.](#_Toc24928)

[Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating SSSG switching (i.e., Beh 2/2A/2B),](#_Toc8934)

[• UE applies SSSG switching on an active BWP of the serving cell at the first slot after the application delay of minimum applicable scheduling offset if a minimum applicable scheduling offset is configured in the BWP,](#_Toc23614)

[• otherwise, UE applies SSSG switching on the BWP of the serving cell at the first slot that is at least P](#_Toc13481)[switch](#_Toc13481) [symbol after the last OFDM symbol of the PDCCH transmission.](#_Toc13481)

[Proposal 12: If Alt 1b is used, the values of Zμ are 4 and 8 for 480kHz and 960kHz, respectively.](#_Toc25473)

[Proposal 13: UE does not expect to be scheduled with DCI format with ‘PDCCH monitoring adaptation’ field indicating another change to PDCCH monitoring behavior for the same active BWP before the previous indication applied.](#_Toc7778)

[Proposal 14: When UE receives a DCI indicating a PDCCH monitoring adaptation and a BWP switching, UE applies the PDCCH monitoring adaptation after BWP switching.](#_Toc2167)

[Proposal 15: If only PDCCH skipping duration list is configured, UE does not perform PDCCH skipping before receiving a DCI indicates PDCCH skipping.](#_Toc26427)

[Proposal 16: If SSSG list is configured, UE performs PDCCH monitoring behavior according to search space sets with group index 0.](#_Toc27734)

[Proposal 17: The following text proposal is proposed:](#_Toc20353)

|  |
| --- |
| TS 38.213**<Unchanged parts are omitted>**10.4 Search space set group switching and skipping of PDCCH monitoringA UE can be provided a group index for a respective Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList* or *searchSpaceGroupIdList\_r17* for PDCCH monitoring on a serving cell. And a UE can be provided a set of durations by *PDCCHSkippingDurationList* for PDCCH monitoring on a serving cell. If the UE is not provided *searchSpaceGroupIdList* or *searchSpaceGroupIdList\_r17* for a search space set, and the UE is not provided *PDCCHSkippingDurationList* for PDCCH monitoring on a serving cell, the following procedures are not applicable for PDCCH monitoring according to the search space set.**<Unchanged parts are omitted>** |

## OPPO

1. **R1-2201282 Remaining issues for DCI-based power saving adaptation OPPO**

***Proposal 1: For 2 SSSG switching, support 2 skipping duration indications.***

***Proposal 2: For the Case 5, i.e., 3 SSSG switching and 1 skipping, it should be possible by configuration.***

***Proposal 3: The search space group switching indication in the DCI can also trigger cross-slot scheduling states.***

***In that case, the application delay of cross-slot is also applicable.***

***Proposal 4: If the scheduling DCI indicates PDCCH monitoring adaptation and BWP switching in different DCI fileds,***

***When PDCCH skipping is indicated, PDCCH skipping duration based on the target BWP configuration starts after BWP switching delay.***

***When SSSG switching is indicated, target BWP configuration of SSSG will be takes effect by the indication after BWP switching delay.***

***Proposal 5: If the active BWP is switched due to the expiration of bwp-InactivityTimer before the end of the PDCCH skipping duration, in the newly active BWP***

***UE starts monitoring PDCCH according to configured SS sets if SSSG is not configured on the new active BWP;***

***UE starts monitoring PDCCH according to SS set in SSSG # on the new active BWP which is the same SSSG# in the source BWP.***

***Proposal 6: Introduce a delay window in the PDCCH skipping indication, which is based on PDCCH-PDSCH-HARQ-ACK timing and re-scheduling timing.***

***Proposal 7: In the delay window for retransmission, PDCCH monitoring can be only after PDCCH-PDSCH-HARQ-ACK timing and in few consecutive monitoring occasions.***

***Proposal 8: Application time is to be introduced in SSSG switching.***

## CATT

1. **R1-2201372 Remaining issues of PDCCH monitoring adaptation CATT**

***Proposal 1: PDCCH skipping indicated by scheduling DCI is not impacted by the PDSCH/PUSCH transmission and the associated HARQ processing when the bit value of PDCCH skipping duration indication changes.***

***Proposal 2：If UE is indicated in skipping an interval of the PDCCH monitoring, UE would keep skipping the interval of PDCCH monitoring and monitor the PDCCH at the next PDCCH monitoring occasion after the skipping interval until UE receives a new PDCCH skipping indication.***

***Proposal 3: The TP 1 below is adopted.***

|  |
| --- |
| --------------------------------- Start of Text Proposal 1 for TS 38.213------------------------------------< Unchanged parts are omitted >**10.4 Search space set group switching and skipping of PDCCH monitoring**< Unchanged parts are omitted >A UE can be provided a set of durations by *PDCCHSkippingDurationList* for PDCCH monitoring on a serving cell and, if the UE is not provided *searchSpaceGroupIdList-r17*, a DCI format 0\_1, and/or DCI format 1\_1, and/or DCI format 0\_2, and/or DCI format 1\_2 that schedules a PUSCH transmission or a PDSCH reception can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits. If the field has 1 bit and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '0' value for the bit indicates no skipping in PDCCH monitoring- a '1' value for the bit indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durationsIf the field has 2 bits and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on a serving cell- a '00' value for the bits indicates no skipping in PDCCH monitoring - a '01' value for the bits indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations- a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the second value in the set of durations- a '11' value for the bits indicates skipping PDCCH monitoring for a duration provided by the third value in the set of durations, if any; otherwise, if the set of durations includes two values, a use of the ‘11’ value is reservedWhen UE is indicated skipping PDCCH monitoring for a duration in a DCI format 0\_1, DCI format 1\_1, DCI format 0\_2, and/or DCI format 1\_2, UE would keep skipping the indicated interval until UE receives a new PDCCH skipping indication.< Unchanged parts are omitted >----------------------------------- End of Text Proposal 1 for TS 38.213-------------------------------------------------- |

***Proposal 4: If a UE is provided with a timer value by searchSpaceSwitchTimer-r17 for PDCCH monitoring adaptation on a serving cell and the timer is running, the UE***

* ***resets the timer after a slot of the active DL BWP of the serving cell when the UE detects an indication of PDCCH monitoring adaptation from DCI received in the slot.***
	+ ***Alt 2a: for the Type3-PDCCH CSS set or the USS set with group index of either 1 or 2***
* ***When the timer expires in a slot:***
	+ ***Alt 1: UE switches to the default SSSG (SSSG 0) regardless if it receives the indication of PDCCH skipping or not.***
* ***otherwise, decrease the timer value by one after each slot.***

***Proposal 5: If the switching timer expiration and PDCCH monitoring occur at the same slot after the PDCCH skipping indicating, UE would not be expected to monitor the PDCCH at the slot SSSG switching to the default SSSG, i.e. SSSG#0, after the application delay.***

***Proposal 6: The TP 2 below is adopted.***

|  |
| --- |
| --------------------------------- Start of Text Proposal 2 for TS 38.213------------------------------------< Unchanged parts are omitted >**10.4 Search space set group switching and skipping of PDCCH monitoring**< Unchanged parts are omitted >If a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell ~~and~~ When the timer is running, the UE- decrements the timer after a slot of an active DL BWP of the serving cell when the UE does not detect a DCI format in a PDCCH reception in the slot ~~for TBD,~~- resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot for ~~TBD~~ the Type3-PDCCH CSS set or the USS set with group index of either 1 or 2.When the timer expires, the UE monitors PDCCH on the serving cell according to search space sets with group index 0. If UE is indicated with skipping PDCCH monitoring and scheduled to monitor PDCCH at the slot when the timer expires, UE would not monitor PDCCH during the SSSG switching. < Unchanged parts are omitted >----------------------------------- End of Text Proposal 2 for TS 38.213-------------------------------------------------- |

***Proposal 7: Confirm the WA: The bit length of the candidate skipping values and SSSG switching initial timer values in slots for 480kHz and 960kHz SCS are assumed to be the same as that for 120KHz SCS***

***Proposal 8: The candidate skipping values and SSSG switching initial timer values in slots, e.g.,***

* + ***The candidate skipping values can be configured as***
		- ***{[4,8,12,16,…,640,1280,1600,2560,3200]} for 480kHz SCS,***
		- ***{[8,16,24,32,…, 1280,1600,2560,3200,6400]} for 960kHz SCS.***
	+ ***The value of the SSSG switching timer in slots can be configured as,***
		- ***{[4,8,12,16,…,640,1280,1600,2560,3200]} for 480kHz SCS,***
		- ***{[8,16,24,32,…, 1280,1600,2560,3200,6400]} for 960kHz SCS.***

***Proposal 9: The application delay of PDCCH skipping does not depend on the outcome of HARQ process of PDSCH/PUSCH and is “ZERO”. The starting time of PDCCH skipping would be applied at the first slot after the received PDCCH with the adaptation indication.***

***Proposal 10: The TP 3 below is adopted.***

|  |
| --- |
| --------------------------------- Start of Text Proposal 3 for TS 38.213------------------------------------< Unchanged parts are omitted >**10.4 Search space set group switching and skipping of PDCCH monitoring**< Unchanged parts are omitted >A UE can be provided a set of durations by *PDCCHSkippingDurationList* for PDCCH monitoring on a serving cell and, if the UE is not provided *searchSpaceGroupIdList-r17*, a DCI format 0\_1, and/or DCI format 1\_1, and/or DCI format 0\_2, and/or DCI format 1\_2 that schedules a PUSCH transmission or a PDSCH reception can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits. If the field has 1 bit and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '0' value for the bit indicates no skipping in PDCCH monitoring- a '1' value for the bit indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durationsIf the field has 2 bits and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on a serving cell- a '00' value for the bits indicates no skipping in PDCCH monitoring - a '01' value for the bits indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations- a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the second value in the set of durations- a '11' value for the bits indicates skipping PDCCH monitoring for a duration provided by the third value in the set of durations, if any; otherwise, if the set of durations includes two values, a use of the ‘11’ value is reservedWhen UE is indicated skipping PDCCH monitoring for a duration in a DCI format 0\_1, DCI format 1\_1, DCI format 0\_2, and/or DCI format 1\_2, the PDCCH skipping would be applied at the first slot after the received the PDCCH skipping indication..< Unchanged parts are omitted >----------------------------------- End of Text Proposal 3 for TS 38.213----------------------------------------------- |

***Proposal 11: The application delay of SSSG switching indicated by scheduling DCI and timer expiration would be the same as that of the legacy SSSG switching by DCI format 2\_0 with switching delay*** $P\_{switch}$***. The SSSG switching is performed for the serving cell at the beginning of the first slot that is at least*** $P\_{switch}$ ***symbols after the last symbol of the PDCCH with the adaptation indication or after a slot where the timer expires.***

***Proposal 12: The TP 4 below is adopted.***

|  |
| --- |
| --------------------------------- Start of Text Proposal 4 for TS 38.213------------------------------------< Unchanged parts are omitted >**10.4 Search space set group switching and skipping of PDCCH monitoring**< Unchanged parts are omitted >A UE can be provided group indexes for a Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList-r17* for PDCCH monitoring on a serving cell and, if the UE is not provided *PDCCHSkippingDurationList*, DCI format 0\_1, or DCI format 1\_1, or DCI format 0\_2, or DCI format 1\_2 that schedules a PUSCH transmission or a PDSCH reception can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits. If the field has 1 bit and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '0' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with other group indexes, if any- a '1' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with other group indexes, if anyIf a UE receives the PDCCH monitoring adaptation indication for a serving cell in a DCI format 0\_1, DCI format 1\_1, DCI format 0\_2, and/or DCI format 1\_2,- if the UE detects a DCI format 0\_1, DCI format 1\_1, DCI format 0\_2, and/or DCI format 1\_2 with a value of the PDCCH monitoring adaptation field in the DCI format is 0, the UE starts monitoring PDCCH according to search space sets with group index 0, and stops monitoring PDCCH according to search space sets with group index 1, for the serving cell at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH with the adaptation indication. - if the UE detects a DCI format 0\_1, DCI format 1\_1, DCI format 0\_2, and/or DCI format 1\_2 with a value of the PDCCH monitoring adaptation field in the DCI format is 1, the UE starts monitoring PDCCH according to search space sets with group index 1, and stops monitoring PDCCH according to search space sets with group index 0, for the serving cell at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH with the adaptation indication, and the UE sets the timer value to the value provided by *searchSpaceSwitchTimer-r17*, if *searchSpaceSwitchTimer-r17* is provided.If the field has 2 bits and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '00' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with other group indexes, if any- a '01' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with other group indexes, if any- a '10' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 2 and stop of PDCCH monitoring according to search space sets with other group indexes, if any- a '11' value is reservedIf a UE receives the PDCCH monitoring adaptation indication for a serving cell in a DCI format 0\_1, DCI format 1\_1, DCI format 0\_2, and/or DCI format 1\_2,- if the UE detects a DCI format 0\_1, DCI format 1\_1, DCI format 0\_2, and/or DCI format 1\_2 with a value of the PDCCH monitoring adaptation field in the DCI format is 00, the UE starts monitoring PDCCH according to search space sets with group index 0, and stops monitoring PDCCH according to search space sets with other group indexes, for the serving cell at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH with the adaptation indication.- if the UE detects a DCI format 0\_1, DCI format 1\_1, DCI format 0\_2, and/or DCI format 1\_2 with a value of the PDCCH monitoring adaptation field in the DCI format is 01, the UE starts monitoring PDCCH according to search space sets with group index 1, and stops monitoring PDCCH according to search space sets with other group indexes, for the serving cell at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH with the adaptation indication, and the UE sets the timer value to the value provided by *searchSpaceSwitchTimer-r17*, if *searchSpaceSwitchTimer-r17* is provided.- if the UE detects a DCI format 0\_1, DCI format 1\_1, DCI format 0\_2, and/or DCI format 1\_2 with a value of the PDCCH monitoring adaptation field in the DCI format is 10, the UE starts monitoring PDCCH according to search space sets with group index 2, and stops monitoring PDCCH according to search space sets with other group indexes, for the serving cell at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH with the adaptation indication, and the UE sets the timer value to the value provided by *searchSpaceSwitchTimer-r17*, if *searchSpaceSwitchTimer-r17* is provided.< Unchanged parts are omitted >When the timer expires, the UE monitors PDCCH on the serving cell according to search space sets with group index 0, for the serving cell at a first slot that is at least $P\_{switch}$ symbols after a slot where the timer expires. ----------------------------------- End of Text Proposal 4 for TS 38.213----------------------------------- |

## NTT DOCOMO, INC.

1. **R1-2201486 Discussion on extension to DCI-based power saving adaptation NTT DOCOMO, INC.**

**Proposal 1: Regarding whether it is applicable to non-LBT case only or both cases of LBT/non-LBT, we propose to leave it to B52.6G session.**

**Proposal 2: Regarding the value of SSSG switching timer and skipping duration for 480 and 960 kHz, the following values should be adopted.**

* + The candidate skipping values can be configured as
		- {4,8,12,16,…,640,1280,1600,2560,3200} for 480kHz SCS,
		- {8,16,24,32,…, 1280,1600,2560,3200,6400} for 960kHz SCS.
	+ The value of the SSSG switching timer in slots can be configured as,
		- {4,8,12,16,…,640,1280,1600,2560,3200} for 480kHz SCS,
		- {8,16,24,32,…, 1280,1600,2560,3200,6400} for 960kHz SCS.

**Proposal 3: Case5 (3 SSSG switching with PDCCH skipping) should be supported.**

## Spreadtrum Communications

1. **R1-2201553 Discussion on power saving techniques for connected-mode UEs Spreadtrum Communications**

***Proposal 1: The application delay for Rel-17 SSSG switching is determined by pipeline switching at UE side, and it can be similar to the application delay of cross-slot scheduling.***

***Proposal 2: The application delay for Rel-17 PDCCH skipping is determined by pipeline switching at UE side, and it can be similar to the application delay of cross-slot scheduling.***

## ETRI

1. **R1-2201613 Remaining issues on DCI-based power saving adaptation during DRX active time ETRI**

**Proposal 1: For DCI format 0\_1/0\_2/1\_1/1\_2, if *PDCCHSkippingDurationList* is not configured and if *searchSpaceGroupIdList-r17* is configured, the PDCCH monitoring adaptation bit field is**

* **1 bit if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2.**
* **2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 2.**

**Proposal 2: Do not support case 5 for Rel-17 DCI-based power saving adaptation.**

**Proposal 3: UE resets the SSSG timer when the UE detects a DCI format with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI (Alt 2c).**

**Proposal 4: UE decreases the SSSG timer by one after each slot irrespective of the PDCCH skipping indication (Alt 3a).**

**Proposal 5: When the timer expires in a slot,**

* + **If the UE has not been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot, the UE monitors PDCCH on the serving cell according to search space sets with group index 0;**
	+ **If the UE has been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot, the UE starts to monitor PDCCH until the completion of the PDCCH skipping for the duration on the serving cell according to search space sets with group index 0. (Alt 1b)**

**Proposal 6: The PDCCH monitoring adaptation indication including SSSG switching and PDCCH skipping is applied after the HARQ-ACK or the PUSCH transmission (or corresponding gNB’s decoding timing).**

**Proposal 7: The application timing is configured by RRC signalling separately with HARQ-ACK or PUSCH transmission timing, with referenced to a slot where the monitoring adaptation indication DCI is transmitted.**

## Panasonic

1. **R1-2201643 Remaining issues for extensions to Rel-16 DCI-based power saving adaptation during DRX Active Time Panasonic**

**Proposal 1: On bit mapping design of DCI indicated PDCCH monitoring adaptation, Case 5 should be supported, where the state ‘11’ UE behaviour is RRC configurable between reserved or skipping.**

**Proposal 2: Confirm the working assumption that the bit length of the candidate skipping values and SSSG switching initial timer values in slots for 480kHz and 960kHz SCS are assumed to be the same as that for 120KHz SCS. In additional, for the candidate skipping values, use scaled values for PDCCH skipping. We are open to discuss 4 or other values.**

**Proposal 3: The candidate values for SSSG switching timer could be same with that of the PDDCH skipping for 480kHz and 960kHz SCS.**

**Proposal 4: PDCCH scrambled by C-RNTI is monitored in Type 0/0A/1/2 CSS.**

**Proposal 5: When a search space is not configured with any SSSG ID, UE continues monitoring PDCCH in this search space without being impact by the DCI-based PDCCH monitoring adaptation.**

Proposal 6: UE resets the timer configured for SSSG switching after a slot when UE detects a DCI format in a PDCCH reception in the slot with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI. Our second preference is UE resets the timer after detecting a DCI format in a slot for the Type3-PDCCH CSS set or the USS set.

Proposal 7: When SSSG timer expires, UE switches to SSSG#0. If this happens within PDCCH skipping duration, UE performs SSSG fallback switching firstly. Then PDCCH skipping continues until the end of PDCCH skipping duration.

Proposal 8: For DCI format 0\_1/1\_1/0\_2/1\_2, the bit width for PDCCH adaptation indication is:

* + 1 bit if UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0 and search space set(s) with group index 1, and if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set with group index 2;
	+ 2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) with group index 0, search space set(s) with group index 1 and search space set(s) with group index 2;

Proposal 9: Regarding the application delay for both PDCCH skipping and SSSG switching, no interaction with retransmission is needed. The application delay could be:

* + With a fixed or zero gap. Or
	+ The application delay for PDCCH processing of Rel-16 minimum application delay for K0min/K2min indication is reused/extended

## Intel Corporation

1. **R1-2201707 Discussion on remaining aspects of power saving in active time Intel Corporation**

**Observation 1: WUS monitoring occasions cannot be missed due to PDCCH skipping which applies to active time only.**

**Proposal 1: Application delay should have no interaction with retransmissions.**

* **Select one of the following for PDCCH skipping**
	+ **Alt 1a: the UE applies Beh 1A on the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.**
	+ **Alt 1b: the application delay needed for PDCCH processing, i.e., Z value, for Rel-16 minimum application delay for K0min/K2min indication is reused/extended**
* **Select the following for SSSG switching**
	+ **The UE applies SSSG switching on the serving cell at a first slot that is at least *Pswitch* symbols after the last symbol of the PDCCH**

**Proposal 2: PDCCH skipping does not apply to search space set provided by recoverySearchSpaceId.**

**Proposal 3: When the UE is indicated to skip PDCCH monitoring for a duration on a serving cell, the UE skips monitoring of PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in Type3 CSS and USS, except when SR is pending, contention resolution timer is running, or RAR window is not expired.**

**Proposal 4: The following RAN2 agreements can be captured in RAN1 specification TS 38.213**

|  |
| --- |
| 1. UE ignores PDCCH skipping while the SR is pending.
2. If PDCCH skipping is applied to RNTI(s) monitored during RAR/MsgB window, the UE ignores PDCCH skipping during the RAR/MsgB window.
3. UE ignores PDCCH skipping while contention resolution timer is running.
 |

**Proposal 5: UE continues CSI report or SRS transmission during PDCCH skipping duration.**

**Proposal 6: If a UE is provided with a timer value by searchSpaceSwitchTimer-r17 for PDCCH monitoring on a serving cell and the timer is running, the UE resets the timer after a slot of the active DL BWP of the serving cell when the UE detects**

**Proposal 7: SSSG switching timer continues to decrement and if expires during skipping duration, UE switches back to default SSSG after skipping duration.**

**Proposal 8: DRX inactivity timer continues to decrement and if expires during skipping duration, UE skips the current DRX cycle.**

**Proposal 9: For DCI format 0\_1, DCI format 0\_2, DCI format 1\_1 and DCI format 1\_2,**

* **1 or 2 bits, if *PDCCHSkippingDurationList* is not configured and if *searchSpaceGroupIdList-r17* is configured**

**-     1 bit if the UE is configured by searchSpaceGroupIdList-r17 with search space set(s) with group index 0 and search space set(s) with group index 1, and if the UE is not configured by searchSpaceGroupIdList-r17 with any search space set with group index 2;**

**-     2 bits if the UE is configured by searchSpaceGroupIdList-r17 with search space set(s) with group index 0, search space set(s) with group index 1 and search space set(s) with group index 2;**

## Apple

1. **R1-2201779 Remaining details on enhanced DCI-based power saving adaptation Apple**

***Proposal 1: In case 2 and case 3,***

* ***When Beh 2/2A and/or 2B are signaled in one DCI, timer is reset when DCI bit carry ‘01’ or ‘10’.***
* ***Otherwise decease the timer by one after each slot.***
* ***When timer expires, fall back to default SSSG.***

***Proposal 2: In case 4 when both Beh 1/1A/2/2A is enabled,***

* ***Timer is reset if the UE detect a DCI format 0-1, 0-2, 1-1 and 1-2 and the value for PDCCH adaptation bit value is set to ‘01’, ‘10’, ‘11’.***
* ***Otherwise, decrease the timer value by one after each slot, if UE does not apply PDCCH skipping.***
* ***When timer expires, fall back to default SSSG.***

***Proposal 3: HARQ retransmission should be taken into consideration for PDCCH skipping and SSSG switching adaptation.***

***Proposal 4: For PDCCH skipping, when triggered by DCI format 1-1 and 1-2, PDCCH skipping applies after the last OFDM symbol of ACK transmission.***

***Proposal 5: For PDCCH skipping, when PDCCH monitoring adaptation is triggered by DCI format 0-1 and 0-2, PDCCH skipping applies after drx-RetransmissionTimerUL expires.***

***Proposal 6: For SSSG switching, when triggered by DCI format 1-1 and 1-2, SSSG switching applies at least Pswitch symbols after the slot of ACK transmission.***

***Proposal 7: For SSSG switching, when triggered by DCI format 0-1 and 0-2, SSSG switching applies at least Pswitch symbols after the slot when drx-RetransmissionTimerUL expires.***

***Proposal 8: When timer expires, UE should start monitoring default SSSG at least Pswitch symbols after the slot when timer expires.***

## CMCC

1. **R1-2201867 Remaining issues on PDCCH monitoring reduction during DRX active time CMCC**

**Proposal 1. If a UE is provided with a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running,**

* **the UE resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot for the Type3-PDCCH CSS set or the USS set with group index of either 1 or 2;**
* **UE switches to the default SSSG (SSSG 0) when the timer expires in a slot.**

**Proposal 2. The TP suggestion for TS 38.213 section 10.4 is as the following:**

* **<**Unchanged text is omitted>
* If a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE
* - resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot for the Type3-PDCCH CSS set or the USS set with group index of either 1 or 2
* - otherwise, decrements the timer after a slot of an active DL BWP of the serving cell
* When the timer expires, the UE monitors PDCCH on the serving cell according to search space sets with group index 0.
* **<**Unchanged text is omitted>

**Proposal 3. For PDCCH skipping application delay, Alt 1a is supported which the UE applies PDCCH skipping on the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.**

**Proposal 4. For PDCCH skipping interaction with HARQ retransmission, Alt 1 is supported which UE still performs PDCCH monitoring when drx-RetransmissionTimerDL/UL is running.**

**Proposal 5. For SSSG switching application delay, Alt 1a is supported which the UE applies SSSG switching on the serving cell at a first slot that is at least *Pswitch* symbols after the last symbol of the PDCCH.**

## Xiaomi

1. **R1-2201919 Remaining issues on PDCCH monitoring adaptation for power saving Xiaomi**

***Proposal 1:***

***For the case that PDCCH monitoring adaptation and BWP switching are indicated in the same DCI, the PDCCH monitoring adaptation can be applied for the new BWP.***

***For the case that BWP switching is indicated after PDCCH monitoring adaptation indication, but before the expiration of PDCCH skipping timer or SSSG switching timer, clear the PDCCH monitoring adaptation indication and all the related running timer associated to the original BWP and go back to a default PDCCH monitoring behaviour in the new BWP.***

***Proposal 2: To allow the PDCCH monitoring adaptation feature applied in NR 52.6-71GHz,***

* ***The value of the SSSG switching timer in slots for SSSG#1 and/or SSSG#2 can be configured as, {[4,8,12,16,...,640,1280,1600,2560,3200]} for 480kHz SCS, {[8,16,24,32,..., 1280,1600,2560,3200,6400]} for 960kHz SCS.***
* ***The candidate skipping values can be configured as {[4,8,12,16,...,640,1280,1600,2560,3200]} for 480kHz SCS, {[8,16,24,32,..., 1280,1600,2560,3200,6400]} for 960kHz SCS.***

## Samsung

1. **R1-2202025 Maintenance on DCI-based power saving techniques Samsung**

**Conclusion #1: Monitoring of PDCCH candidates in Type0/0A/1 or 2 PDCCH CSS is not affected by PDCCH monitoring adaptation.**

* **Adopt proposed TP #1 for TS 38.213**

**Proposal #1: UE cancels PDCCH skipping adaptation after transmission of a postive SR.**

**Proposal #2: UE cancels PDCCH skipping adaptation after transmission of PRACH.**

**Proposal #3: Down-select Alt 2a for resetting the timer value by searchSpaceSwitchTimer-r17.**

* **Adopt proposed TP #2 for TS 38.213**

**Proposal #4: Down-select Alt 1b for UE behavior when the *searchSpaceSwitchTimer-r17* timer expires in a slot.**

**Proposal 5: For PDCCH monitoring adaptation indication, reuse Rel-16 minimum application delay for K0min/K2min indication.**

* **UE can continue receiving scheduling PDCCH during the application delay of a PDCCH monitoring adaptation indication, but the UE doesn’t expect to different PDCCH monitoring adaptation indication during the application delay.**
* **Adopt proposed TP #3 for 38.213**

**Proposal #6: In the case of PDCCH skipping interaction with HARQ retransmission, support**

* **During PDCCH skipping duration, the UE still performs PDCCH monitoring (i.e., Beh 1) when *drx-RetransmissionTimerDL/UL* is running**

## MediaTek Inc.

1. **R1-2202070 Maintenance on DCI-based PDCCH Monitoring Adaptation MediaTek Inc.**

**Proposal 1: Focus on resolving the high priority issues in Table 1, and deprioritize the low priority issue with which the feature is still functional.**

**Table 1. Identified issues and the suggested priorities**

|  |  |
| --- | --- |
| **High priority issue** | **Low priority issue** |
| * Ambiguity in judging number of configured SSSGs
* SSSG timer update within and after PDCCH skipping duration
* Monitoring in PDCCH skipping duration
* Application delay
* Interaction between BWP switching and Rel-17 power saving adaptation
* Alignment with RAN2 agreements in R1-2200884 (R2-2201960), RAN2 LS on PDCCH skipping
 | * Case 5: PDCCH skipping + 3 SSSG
 |

**Observation 1: Among the solutions without RRC impact, option 2 allows UE to explicitly decide the bit number of the PDCCH monitoring adaptation bit field with the simplest implementation.**

**Observation 2: Although bit field size ambiguity is resolved, empty SSSG is still possible to be configured by either of the following**

* **Not label any search space set to the SSSG**
* **Configure a search space without *nrofCandidates*.**



**Figure 1. Example of possible configuration to realize an empty SSSG**

**Proposal 2: Support Option 2 to resolve the ambiguity issue in the size of PDCCH monitoring adaptation bit field.**

**Proposal 3: Support the following text proposal for PDCCH monitoring adaptation indication field in Sections 7.3.1.1.2, 7.3.1.1.3, 7.3.1.2.2 and 7.3.1.2.3 of TS 38.212**

|  |
| --- |
| <Unchanged parts are omitted>- 1 or 2 bits, if *PDCCHSkippingDurationList* is not configured and if *searchSpaceGroupIdList-r17* is configured- 1 bit if the UE is not configured by *searchSpaceGroupIdList-r17* with any search space set associated with group index 2;- 2 bits if the UE is configured by *searchSpaceGroupIdList-r17* with search space set(s) associated with group index 2;<Unchanged parts are omitted> |

**Proposal 4: Support Alt 2c. Reset SSSG timer when the UE receives PDCCH scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI**.

**Proposal 5: Support Alt 3a-modified. Decrease SSSG timer when the UE does not receive a scheduling DCI with PDCCH monitoring adaptation field and the UE is not indicated skipping PDCCH monitoring.**

**Proposal 6: Adopt the following text proposal for SSSG timer mechanism in Section 10.4 of TS 38.213**

|  |
| --- |
| <Unchanged parts are omitted>If a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE- decrements the timer after a slot of an active DL BWP of the serving cell when the UE does not detect a DCI format in a PDCCH reception in the slot ~~for~~ with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI and, UE is not indicated skipping PDCCH monitoring - resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot ~~for~~ with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTIWhen the timer expires, the UE monitors PDCCH on the serving cell according to search space sets with group index 0.<Unchanged parts are omitted> |

**Proposal 7: UE skips monitoring of PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, or CS-RNTI in any CSS and USS when UE is indicated skipping PDCCH monitoring for a duration.**

**Proposal 8: Adopt the following text proposal for PDCCH monitoring in Section 10.1 of TS 38.213**

|  |
| --- |
| <Unchanged parts are omitted>If a UE is provided - one or more search space sets by corresponding one or more of *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *ra-SearchSpace*, and - a C-RNTI, an MCS-C-RNTI, or a CS-RNTIthe UE monitors PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in the one or more search space sets in a slot where the UE monitors PDCCH candidates for at least a DCI format 0\_0 or a DCI format 1\_0 with CRC scrambled by SI-RNTI, RA-RNTI, MsgB-RNTI, or P-RNTI. If the UE is indicated skipping PDCCH monitoring for a duration as described in clause 10.4 and, the UE skips monitoring PDCCH candidates for DCI format 0\_0 and DCI format 1\_0 with CRC scrambled by the C-RNTI, the MCS-C-RNTI, or the CS-RNTI in the above search space set(s).<Unchanged parts are omitted> |

**Proposal 9: Support Alt 1a for PDCCH skipping, UE starts to skip monitoring PDCCH at the first slot after the last OFDM symbol of the PDCCH transmission.**

**Proposal 10: Support Alt 1a for SSSG switching, UE switches to another SSSG after**$ P\_{switch}$ **from the start of next slot of the DCI indication (same behavior as Rel-16**)

**Observation 3: Retransmission handling issue can be avoided by network implementation, e.g., applying lower MCS for the last TB or triggering skipping by a (dummy) UL scheduling after confirming all DL TBs are correctly decoded by UE. Although either of the above network solutions can be further optimized for reduced system overhead, such optimization can be left to Rel-18.**

**Proposal 11: Support Alt 0, not to introduce additional UE behavior for retransmission handling in** Rel-17.

**Proposal 12: Adopt the following text proposal for application delay in Section 10.4 of TS 38.213**

|  |
| --- |
| <Unchanged parts are omitted>A UE can be provided a set of durations by *PDCCHSkippingDurationList* for PDCCH monitoring on a serving cell and, if the UE is not provided *searchSpaceGroupIdList-r17*, a DCI format 0\_1, and/or DCI format 1\_1, and/or DCI format 0\_2, and/or DCI format 1\_2 that schedules a PUSCH transmission or a PDSCH reception can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits. If the field has 1 bit and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '0' value for the bit indicates no skipping in PDCCH monitoring- a '1' value for the bit indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations, starting at a first slot after the last symbol of the PDCCHIf the field has 2 bits and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on a serving cell- a '00' value for the bits indicates no skipping in PDCCH monitoring - a '01' value for the bits indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations, starting at a first slot after the last symbol of the PDCCH- a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the second value in the set of durations, starting at a first slot after the last symbol of the PDCCH- a '11' value for the bits indicates skipping PDCCH monitoring for a duration provided by the third value in the set of duration if any; otherwise, if the set of durations includes two values, a use of the ‘11’ value is reservedA UE can be provided group indexes for a Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList-r17* for PDCCH monitoring on a serving cell and, if the UE is not provided *PDCCHSkippingDurationList*, DCI format 0\_1, or DCI format 1\_1, or DCI format 0\_2, or DCI format 1\_2 that schedules a PUSCH transmission or a PDSCH reception can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits. If the field has 1 bit and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '0' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH- a '1' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCHIf the field has 2 bits and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '00' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH- a '01' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH- a '10' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 2 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH- a '11' value is reservedA UE can be provided a set of durations by *PDCCHSkippingDurationList* and group indexes for a Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList-r17* for PDCCH monitoring on a serving cell and, a DCI format 0\_1, and/or DCI format 1\_1, and/or DCI format 0\_2, and/or DCI format 1\_2 that schedules a PUSCH transmission or a PDSCH reception can include a PDCCH monitoring adaptation field of 2 bits. If the set of durations includes one value and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '00' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with group index 1, if any, at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH- a '01' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with group index 0, if any, at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH- a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the value in the set of durations, starting at a first slot after the last symbol of the PDCCH- a '11' value is reservedIf the set of durations includes two values and for PDCCH monitoring according to Type3-PDCCH CSS sets or USS sets on the serving cell- a '00' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with group index 1, if any, at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH- a '01' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with group index 0, if any, at a first slot that is at least $P\_{switch}$ symbols after the last symbol of the PDCCH- a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations, starting at a first slot after the last symbol of the PDCCH- a '11' value for the bits indicates skipping PDCCH monitoring for a duration provided by the second value in the set of durations, starting at a first slot after the last symbol of the PDCCH<Unchanged parts are omitted> |

**Proposal 13: If UE changes BWP due to a BWP inactivity timer expiration, UE applies the default monitoring behavior and reset every SSSG timer based on the target BWP setting**

**Proposal 14: Adopt the following text proposal as a new paragraph in the end of Section 10.4 of TS 38.213**

|  |
| --- |
| <Unchanged parts are omitted>If UE changes an active DL BWP due to a BWP inactivity timer expiration, UE monitors PDCCH, assuming PDCCH monitoring adaptation field of value zero, after the active DL BWP change.<Unchanged parts are omitted> |

**Proposal 15: Adopt the following text proposal as a new paragraph in the end of Section 10.4 of TS 38.213**

|  |
| --- |
| <Unchanged parts are omitted>If the UE starts the *ra-ResponseWindow* or the *msgB-ResponseWindow* orthe *ra-ContentionResolutionTimer* as described in [11, TS 38.321], the UE resumes PDCCH monitoring.If a Scheduling Request is sent on PUCCH and is pending, the UE resumes PDCCH monitoring. <Unchanged parts are omitted> |

## Lenovo

1. **R1-2202094 Enhanced DCI based power saving adaptation Lenovo**

**Proposal 1: An application delay for PDCCH skipping can be zero, or a PDCCH processing delay Zµ in Table 5.3.1-1 of TS 38.214 if cross-slot scheduling adaptation configured.**

**Proposal 2: An application delay for SSSG switching can be *Pswitch* in Table 10.4-1 of TS38.213, or the maximum of a PDCCH processing delay Zµ in Table 5.3.1-1 of TS 38.214 and *Pswitch* if cross-slot scheduling adaptation configured.**

**Proposal 3: Upon detecting a DCI format indicating PDCCH skipping, UE monitors PDCCH (does not apply PDCCH skipping) in UE-specific search spaces and Type-3 common search spaces,**

* **for DL DCI format(s), if *drx-RetransmissionTimerDL* is running, and**
* **for UL DCI format(s), if *drx-RetransmissionTimerUL* is running.**

**Proposal 4: If a search space switch timer expires in a slot that is in an indicated PDCCH skipping duration, UE starts monitoring PDCCH on the serving cell according to search space sets with group index 0 after the indicated PDCCH skipping duration ends.**

Text proposal for TS 38.213 is shown below:

**-------------------------- Start of Text Proposal for TS 38.213 ----------------------------------------------------------------**

**10.4 Search space set group switching and skipping of PDCCH monitoring**

\*\*\* Unchanged text is omitted \*\*\*

If a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE

- decrements the timer after a slot of an active DL BWP of the serving cell when the UE does not detect a DCI format in a PDCCH reception in the slot for Type3-PDCCH CSS sets or USS sets with group index 1 or 2

- resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot for Type3-PDCCH CSS sets or USS sets with group index 1 or 2

When the timer expires in a slot,

* if the slot is in an indicated PDCCH skipping duration, the UE starts monitoring PDCCH on the serving cell according to search space sets with group index 0 after the indicated PDCCH skipping duration ends;
* otherwise, the UE starts monitoring PDCCH on the serving cell according to search space sets with group index 0 at the beginning of the first slot that is at least symbols after the slot.

\*\*\* Unchanged text is omitted \*\*\*

**-------------------------- End of Text Proposal for TS 38.213 -------------------------------------------------------------**

## Qualcomm Incorporated

1. **R1-2202150 DCI-based power saving adaptation during DRX ActiveTime Qualcomm Incorporated**

Proposal 1: Monitoring of PDCCH candidate for DCI formats with CRC scrambled by SI-RNTI, RA-RNTI, MsgB-RNTI, or P-RNTI is not affected by PDCCH skipping.

Proposal 3: If a UE is provided with a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring on a serving cell and the timer is running, the UE

* resets the timer after a slot of the active DL BWP of the serving cell when the UE detects a DCI format in a PDCCH reception in the slot with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI (Alt 2c).
* Otherwise, decrease the timer value by one after each slot (Alt 3a).
* When the timer expires in a slot (Alt 1b),
	+ If the UE has not been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot, the UE monitors PDCCH on the serving cell according to search space sets with group index 0;
	+ If the UE has been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot, the UE starts to monitor PDCCH after the completion of the PDCCH skipping for the duration on the serving cell according to search space sets with group index 0.

Proposal 4: For the application delay of PDCCH monitoring adaptation

* **PDCCH skipping (Alt 1a):**
	+ **the UE applies Beh 1A on the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.**
* **SSSG switching (Alt 1a):**
	+ **the UE applies SSSG switching on the serving cell at a first slot that is at least *Pswitch* symbols after the last symbol of the PDCCH**
* **Upon SSSG timer expiry, UE performs Beh 2 at a first slot that is at least *Pswitch* symbols after a slot where the timer expires.**

## Ericsson

1. **R1-2202219 Maintenance for active time power savings mechanisms Ericsson**

[Proposal 1 If](#_Toc95739247) *[PDCCHSkippingDurationList](#_Toc95739247)* [is not configured, the width of the PDCCH monitoring adaptation bitfield is:](#_Toc95739247)

[- 1 bit if the UE is configured by searchSpaceGroupIdList-r17 with search space set(s) with group index 0 and search space set(s) with group index 1, and if the UE is not configured by searchSpaceGroupIdList-r17 with any search space set with group index 2;](#_Toc95739248)

[- 2 bits if the UE is configured by searchSpaceGroupIdList-r17 with search space set(s) with group index 0, search space set(s) with group index 1 and search space set(s) with group index 2.](#_Toc95739249)

[Proposal 2 For Beh 1, a '0' or ‘00’ value for the bit implies that the corresponding DCI is not used for PDCCH skipping indication.](#_Toc95739250)

[Proposal 3 The SSSG timer is reset when UE receives a PDCCH with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI.](#_Toc95739251)

[Proposal 4 If the SSSG-switching timer expires and the UE is still in the skipping duration, the UE finishes the skipping duration and monitors PDCCH according to SSSG0 when skipping duration ends.](#_Toc95739252)

[Proposal 5 UL scheduling request can be used as an implicit indication for PDCCH monitoring adaptation (to end the skipping or to switch to an SSSG). The SSSG (if configured) that UE monitors after transmitting an UL scheduling request is configurable by NW.](#_Toc95739253)

[Proposal 6 For UE configured with DRX, higher layer signaling can configure SSSG that a UE monitors when coming out of DRX to monitor an ON duration.](#_Toc95739254)

[Proposal 7 The minimum application delay from SSSG-switching feature (as described in 38.213-h00, 10.4-1) is reused for Rel-17.](#_Toc95739255)

[Proposal 8 For SSSG-switching via DL scheduling DCI, UE applies switching command (i.e., to the indicated SSSG) after transmitting HARQ-ACK feedback.](#_Toc95739256)

[Proposal 9 For PDCCH-skipping via scheduling DCI, UE applies the skipping at the first slot after the last OFDM symbol containing the skipping indication.](#_Toc95739257)

[Proposal 10 If the UE fails to decode the PDSCH (and transmits a NACK), skipping is canceled in the slots after the NACK transmission (if any).](#_Toc95739258)

[Proposal 11 When the BWP inactivity timer expires, the UE starts the target BWP with the default state (e.g., SSSG0).](#_Toc95739259)

[Proposal 12 When the source BWP is not configured with PDCCH monitoring adaptation and the target BWP is configured with PDCCH monitoring adaptation, the target BWP starts with the default state (e.g., SSSG0).](#_Toc95739260)

[Proposal 13 When the source BWP is configured with PDCCH monitoring adaptation and the target BWP is not configured with PDCCH monitoring adaptation, the PDCCH monitoring adaptation bitfield when BWP-switching indicated, is ignored.](#_Toc95739261)

## InterDigital, Inc.

1. **R1-2202249 Remaining issues on DCI-based power saving adaptation InterDigital, Inc.**

**Proposal 1**: **For PDCCH skipping, application delay has interaction with retransmission and can be applied before HARQ-ACK transmission.**

* **Case 1: Upon detecting a scheduling DCI format 1-1/1-2 indicating PDCCH skipping (i.e., Beh 1A),**
	+ **The UE applies Beh 1A on the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.**
		- **The UE still performs PDCCH monitoring (i.e., Beh 1) when drx-RetransmissionTimerDL is running.**
* **Case 2: Upon detecting a scheduling DCI format 0-1/0-2 indicating PDCCH skipping (i.e., Beh 1A)**
	+ **The UE applies Beh 1A on the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.**
		- **The UE still performs PDCCH monitoring (i.e., Beh 1) when *drx-RetransmissionTimerUL* is running.**

**Proposal 2: For SSSG switching, support no interaction with retransmission.**

* **Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating SSSG switching (i.e., Beh 2/2A/2B)**
	+ **The UE applies SSSG switching on the serving cell at a first slot that is at least *Pswitch* symbols after the last symbol of the PDCCH.**
* **Upon SSSG timer expiry, UE performs Beh 2 at a first slot that is at least *Pswitch* symbols after a slot where the timer expires.**

## Nokia, Nokia Shanghai Bell

1. **R1-2202330 Open issues on PDCCH monitoring adaptation for UE power saving Nokia, Nokia Shanghai Bell**

In Section 1 we discuss the looked the timer related behaviour and concluded as follows:

**Proposal: If UE receives DCI format x\_1/x\_2 indicating no SSSG switch (i.e. field value corresponds to the active SSSG), or a DCI format x\_0 scrambled with C-RNTI/CS-RNTI/MCS-C-RNTI, UE resets the SSSG switching timer.**

**Observation:** *In case UE detects other DCIs that are not scrambled by C-RNTI or does not detect any DCI, UE should continue counting the timer.*

In Section 3 we considered other open aspects related to the PDCCH monitoring adaptation for certain MO originated behaviours, in light of the RAN2 LS [3], we observe and propose in Section 2.2:

**Observation:** *Based on RAN2 LS, in case of triggering SR, normal PDCCH monitoring should be resumed and PDCCH skipping stopped.*

**Observation:** *Based on RAN2 LS, in case of triggering RACH procedure, skipping should be stopped for the duration of the RACH procedure.*

**Observation:** *SR triggering is not distinguished in RACH procedure in RAN1 specification.*

**Proposal: To ensure connectivity, BFD and BFR are accounted in PDCCH monitoring adaptation behaviour.**

**Observation:** *In case of BFR via CBRA, while RA-RNTI and TC-RNTI monitoring are not affected by PDCCH monitoring adaptation, it would be good to ensure that after BFR completion UE would monitor PDCCH also in USS.*

**Observation:** *In case of BFR via CFRA, PDCCH monitoring adaptation should not affect the PDCCH monitoring in recovery search space to enable completion of procedure. Also, to enable further beam management actions, UE should resume normal monitoring after BFR.*

**Proposal: Agree that when RACH procedure is triggered, UE should to stop the PDCCH skipping.**

* **This covers RACH triggering due to SR transmission and initiation of beam failure recovery.**

**Proposal: Answer to RAN2 question 1 as follows:**

|  |
| --- |
| * PDCCH monitoring skipping is not applied to Type2-PDCCH CSS where DCI format with CRC scrambled with a RA-RNTI, a MsgB-RNTI, or a TC-RNTI is monitored during RAR/MsgB window.
* RAN1 also notes that in case of CFRA based BFR, UE monitors PDCCH in *recoverySearchSpaceId* until the UE receives MAC CE configuring UE with new PDCCH beam or timer *beamFailureRecoveryTimer* expires. To ensure proper BFR handling, RAN1 agreed to stop skipping and resume normal PDCCH monitoring upon RACH triggering.
 |

**Observation:** *BSR related behaviour can be addressed by proper selection of UL TB related behaviour.*

In Section 4, for the application delay we make following proposal:-

**Proposal: Any application delay for PDCCH skipping could be left for UE implementation to be handled withing the boundaries of skipping duration.**

The operation in relation to HARQ feedback and pending UL transmissions is discussed in Section 5 and we observe and propose as follows:-

**Observation:** *For SSSG switching case, where UE still continues to monitor PDCCH, albeit at reduced rate, there may not be any need to have special handling of HARQ re-transmissions or UL TB, but scheduling can follow the applied SS set(s).*

**Observation:** *Special handling of HARQ re-transmissions or UL TB is only needed when UE stops the PDCCH monitoring for extended time.*

**Proposal: For stopping PDCCH monitoring based on PDCCH skipping, support configuring timers for defining time windows for handling the open re-transmissions similarly as in C-DRX operation.**

**Proposal: Clarify the UE behaviour in case of PDCCH skipping during the Active time when receiving DCI with different indications during the re-transmission timerso that UE should follow the latest indication*.***

To conclude the interaction with C-DRX operation in Section 6 we make following observations and proposals:-

**Observation:** *Work item determines the scope to be DRX Active Time, thus interaction with inactivity timer should be defined.*

**Observation:** *UE can already skip PDCCH monitoring during onDuration with DCP related procedures defined in Rel-16.*

**Observation:** *If skipping duration is extended outside C-DRX Active time, and DCP monitoring is skipped, physical layer should still indicating value 1 for the Wake-up indication bit to higher layers as defined in Rel-16 to ensure that PDCCH monitoring happens as expected.*

**Proposal:** **If skipping duration overlaps with DCP monitoring, physical layer should indicating value 1 for the Wake-up indication bit to higher layers.**

**Proposal:** **If skipping duration overlaps with** *drx-RetransmissionTimerDL/UL***, UE should stop skipping and resume normal PDCCH monitoring for the duration of** *drx-RetransmissionTimerDL/UL***.**

**Proposal:** **PDCCH skipping duration expires upon expiry of inactivity timer (*drx-InactivityTimer*). When inactivity timer expires, UE falls back to default SSSG (or to configured SSSG).**

**Proposal: Answer to RAN2 question 3 as follows:**

|  |
| --- |
| * RAN1 has not concluded whether skipping duration is extended beyond C-DRX Active time. However, if DCP monitoring would collide with PDCCH skipping duration, RAN1 specification defines that if UE is not required to monitor PDCCH for detection of DCI format 2\_6 (as described in clauses 10, 11.1, 12, and in clause 5.7 of [11, TS 38.321]) UE reports a value of 1 for the Wake-up indication bit to higher layers for the next long DRX cycle as described in Approach 2.
 |

**Proposal:** **Consider support configuring of SSSG that is applied at the start of onDuration when the inactivity timer has expired.**

In Section 7, aspects on other UE behaviour are discussed with following observation and proposal:-

**Observation:** *PDCCH monitoring adaptation affects only to UE PDCCH monitoring, and does not impact on other UE DL monitoring nor UL transmission.*

**Proposal: Answer to RAN2 question 4 as follows:**

|  |
| --- |
| * RAN1 has only agreed adaptation of PDCCH monitoring, either via SSSG switching or PDCCH skipping. UE should continue transmitting CSI/SRS during the skipping duration.
 |

In Section 8 we propose definition of the durations for the higher scs, 480kHz and 960kHz:

**Proposal:** **Skipping duration is always extended till slot group boundary.**

**Proposal:** **Range of skipping duration values for 480kHz and 960kHz are defined as follows:**

* **{2,3,4,8,12,16,…636,640,720,…,1200,1280, 1440, 1600, 1760,…,3040,3200} for 480kHz SCS**
* **{2,4,7,8,16,24,…1280,1440,1600,2400,2560,2880,3200,…,6080,6400 } for 960kHz SCS**

Finally in Section 9 we discuss the inter-working with minimum cross-slot scheduling offset and observe and propose as follows:

**Observation:** *Associating a minimum scheduling offset value with a specific SSSG can reduce the signaling and enhance UE power saving and/or data delay.*

**Proposal: RAN1 to define a minimum scheduling offset (K0,min/K2,min) per SSSG.**

## LG Electronics

1. **R1-2202348 Discussion on DCI-based power saving adaptation during DRX ActiveTime LG Electronics**

***Observation 1: Based on TS38.213 and TS38.321, legacy UE monitors PDCCH candidates for a DCI with CRC scrambled by C-RNTI in a Type0/0A/1/2-PDCCH CSS set for a duration.***

***Observation 2: If monitoring behavior of Observation 1 is applied without modification to a UE indicated to skip for a duration, it will decrease power saving efficiency of monitoring adaptation.***

***Observation 3: Supporting SSSG switching to emulate PDCCH skipping functionality, i.e. Beh 2B, is impossible if PDCCH skipping means shutting down UE’s monitoring PDCCH candidates for a DCI with CRC scrambled by RNTIs controlled by a DRX functionality.***

***Proposal 1: After receiving indication of PDCCH skipping, a UE should not monitor PDCCH candidates for a DCI with CRC scrambled by C-RNTI (and MCS-C-RNTI, CS-RNTI) in a Type0/0A/1/2-PDCCH CSS set for a skipping duration.***

***Proposal 2: Determine the bit-width of PDCCH monitoring adaptation indication field based on the number of supported SSSGs or explicit higher layer parameter.***

***Proposal 3: The bit-width of PDCCH monitoring adaptation indication field determines the configurability of ‘empty’ SSSG.***

***Observation 4: UE’s behavior after switching to ‘empty’ SSSG should be defined.***

***Observation 5: If the DCI based indication is an only option for SSSG switching when timer is not configured, fallback behavior from ‘empty’ SSSG to other SSSG may not work properly.***

***Proposal 4: For SSSG which is configured to ‘empty’, support one of following alternatives:***

* ***Alt 1: Introduce default timer that can be used when a UE is indicated to switch to SSSG with no timer configured.***
* ***Alt 2: Switching timer should be configured.***

***Proposal 5: Support the following alternatives for timer behavior***

* ***Alt 2b or Alt 2c for resetting timer***
* ***Alt 3a for decreasing timer***
* ***Alt 1b for timer expiration***

***Proposal 6: Support that a UE applies SSSG switching on the serving cell after the last OFDM symbol of HARQ-ACK transmission/PUSCH transmission upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating SSSG switching (i.e., Beh 2/2A/2B).***

***Proposal 7: Support that a UE applies Beh 1A after the last OFDM symbol of ACK transmission to handle the case of PDCCH skipping interaction with HARQ retransmission, otherwise the indication is not applied.***

***Proposal 8: PDCCH monitoring adaptation should be terminated upon expiry of drx-InactivityTimer.***

***Proposal 9: Support implicit PDCCH monitoring adaptation triggered by SR and RACH***

* + ***Discuss whether and how to define a monitoring window for a UL grant regarding SR***

## NEC

1. **R1-2202365 Remaining issues on DCI-based power saving adaptation NEC**

**Proposal 1: Support RRC parameter configured for the PDCCH monitoring adaptation indication field presence/absence in DCI format x-2.**

**Proposal 2: Support PDCCH monitoring skipping duration as multiple of** **PDCCH monitoring periodicity.**

**Proposal 3: Support consecutive PDCCH monitoring in multi-slot steps during*****Ts* for UE Power Saving.**

## Nordic

1. **R1-2202386 On PDCCH monitoring adaptation Nordic Semiconductor ASA**

***Proposal-1:*** *Select Option 2 for determining the number of bits of SSSG switching DCI field.*

***Proposal-2:*** *Adopt Alt 2b, which follows the same principle as in R16 NR-U SSSG switching.*

***Observation-1:*** *If Alt 2b is adopted and if skipping duration is always smaller than SSSG switching timer initial value then interaction between SSSG switching and PDCCH skipping can be avoided.*

***Proposal-3:*** *For application delay,**select Alt-1a for SSSG group switching and select Alt-1a for PDCCH skipping.*

***Proposal-4****: UE may discard all PDCCH in USS or TYPE-3 after PDCCH (or after slot boundary following PDCCH) indicating skipping duration and until the end of that indicated skipping duration.*

## Contributions from AI 5

## vivo

1. **R1-2201047 Discussion on PDCCH skipping vivo**
2. **R1-2201048 Draft LS reply on PDCCH skipping vivo**

## ZTE, Sanechips

1. **R1-2201141 Discussion on PDCCH skipping in RRC\_CONNECTED ZTE, Sanechips**
2. **R1-2201142 Draft reply LS on PDCCH skipping in RRC\_CONNECTED ZTE, Sanechips**

## CATT

1. **R1-2201321 Discussion of RAN2 LS on PDCCH skipping in RRC\_CONNECTED CATT**
2. **R1-2201322 Draft reply LS on PDCCH skipping in RRC\_CONNECTED CATT**

## CMCC

1. **R1-2201828 Discussion on RAN2 LS on PDCCH skipping in RRC\_CONNECTED CMCC**

## Samsung

1. **R1-2201975 Draft Reply to RAN2 LS on PDCCH Skipping in RRC\_CONNECTED Samsung**

## MediaTek Inc.

1. **R1-2202066 Discussion on RAN2 LS on PDCCH Skipping in RRC\_CONNECTED MediaTek Inc.**

## Ericsson

1. **R1-2202215 Discussion on PDCCH skipping Ericsson**

## LG Electronics

1. **R1-2202333 Disccusion on LS on PDCCH Skipping in RRC\_CONNECTED LG Electronics**

## Huawei, HiSilicon

1. **R1-2202428 Discussion on RAN2 LS on PDCCH Skipping in RRC\_CONNECTED Huawei, HiSilicon**

# Void

# Work Item Description

*NR\_UE\_pow\_sav-Core; WID in [RP-200938](http://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_88e/Docs/RP-200938.zip). The objectives are as follows*

|  |
| --- |
| 1. Specify enhancements for idle/inactive-mode UE power saving, considering system performance aspects [RAN2, RAN1]
	1. Study and specify paging enhancement(s) to reduce unnecessary UE paging receptions, subject to no impact to legacy UEs [RAN2, RAN1]
* NOTE: RAN1 to check and update, if needed, evaluation methodology in RAN1 #102-e meeting
	1. Specify means to provide potential TRS/CSI-RS occasion(s) available in connected mode to idle/inactive-mode UEs, minimizing system overhead impact [RAN1]
* NOTE: Always-on TRS/CSI-RS transmission by gNodeB is not required
1. Study and specify, if agreed, enhancements on power saving techniques for connected-mode UE, subject to minimized system performance impact [RAN1, RAN4]
	1. Study and specify, if agreed, extension(s) to Rel-16 DCI-based power saving adaptation during DRX Active Time for an active BWP, including PDCCH monitoring reduction when C-DRX is configured [RAN1]
* NOTE: Rel-15 and Rel-16 available power saving solutions should be supported by the UE and included in the evaluation. RAN1 will ask the confirmation from RAN2 that Rel-15 and Rel-16 available power saving solutions are properly utilized.
	1. Study the feasibility and performance impact of relaxing UE measurements for RLM and/or BFD, particularly for low mobility UE with short DRX periodicity/cycle, and specify, if agreed, relaxation in the corresponding requirements [RAN4]
* NOTE: Supplementary RAN2 work, if needed, can be triggered by RAN4 LS
 |

# Reference

**The following contributions are submitted in RAN1#108-E in AI 8.7.2,**

1. R1-2200946 Remaining issues on the extensions to Rel-16 DCI-based power saving adaptation for an active BWP Huawei, HiSilicon
2. R1-2201103 Remaining issues on DCI-based power saving adaptation in connected mode vivo
3. R1-2201133 Remaining issues of PDCCH monitoring adaptation during DRX Active Time ZTE, Sanechips
4. R1-2201282 Remaining issues for DCI-based power saving adaptation OPPO
5. R1-2201372 Remaining issues of PDCCH monitoring adaptation CATT
6. R1-2201486 Discussion on extension to DCI-based power saving adaptation NTT DOCOMO, INC.
7. R1-2201553 Discussion on power saving techniques for connected-mode UEs Spreadtrum Communications
8. R1-2201613 Remaining issues on DCI-based power saving adaptation during DRX active time ETRI
9. R1-2201643 Remaining issues for extensions to Rel-16 DCI-based power saving adaptation during DRX Active Time Panasonic
10. R1-2201707 Discussion on remaining aspects of power saving in active time Intel Corporation
11. R1-2201779 Remaining details on enhanced DCI-based power saving adaptation Apple
12. R1-2201867 Remaining issues on PDCCH monitoring reduction during DRX active time CMCC
13. R1-2201919 Remaining issues on PDCCH monitoring adaptation for power saving Xiaomi
14. R1-2202025 Maintenance on DCI-based power saving techniques Samsung
15. R1-2202070 Maintenance on DCI-based PDCCH Monitoring Adaptation MediaTek Inc.
16. R1-2202094 Enhanced DCI based power saving adaptation Lenovo
17. R1-2202150 DCI-based power saving adaptation during DRX ActiveTime Qualcomm Incorporated
18. R1-2202219 Maintenance for active time power savings mechanisms Ericsson
19. R1-2202249 Remaining issues on DCI-based power saving adaptation InterDigital, Inc.
20. R1-2202330 Open issues on PDCCH monitoring adaptation for UE power saving Nokia, Nokia Shanghai Bell
21. R1-2202348 Discussion on DCI-based power saving adaptation during DRX ActiveTime LG Electronics
22. R1-2202365 Remaining issues on DCI-based power saving adaptation NEC
23. R1-2202386 On PDCCH monitoring adaptation Nordic Semiconductor ASA

**The following contributions are submitted in RAN1#108-E in AI 5**

1. R1-2201047 Discussion on PDCCH skipping vivo
2. R1-2201048 Draft LS reply on PDCCH skipping vivo
3. R1-2201141 Discussion on PDCCH skipping in RRC\_CONNECTED ZTE, Sanechips
4. R1-2201142 Draft reply LS on PDCCH skipping in RRC\_CONNECTED ZTE, Sanechips
5. R1-2201321 Discussion of RAN2 LS on PDCCH skipping in RRC\_CONNECTED CATT
6. R1-2201322 Draft reply LS on PDCCH skipping in RRC\_CONNECTED CATT
7. R1-2201625 Remaining issues on UL prioritization and UL skipping Huawei, HiSilicon
8. R1-2201828 Discussion on RAN2 LS on PDCCH skipping in RRC\_CONNECTED CMCC
9. R1-2201975 Draft Reply to RAN2 LS on PDCCH Skipping in RRC\_CONNECTED Samsung
10. R1-2202066 Discussion on RAN2 LS on PDCCH Skipping in RRC\_CONNECTED MediaTek Inc.
11. R1-2202215 Discussion on PDCCH skipping Ericsson
12. R1-2202333 Disccusion on LS on PDCCH Skipping in RRC\_CONNECTED LG Electronics
13. R1-2202428 Discussion on RAN2 LS on PDCCH Skipping in RRC\_CONNECTED Huawei, HiSilicon

**Other references:**

1. RP-200938, “Revised WID: UE Power Saving Enhancements for NR”, MediaTek Inc., RAN#88-e
2. [R1-2200833](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107b-e/Docs/R1-2200833.zip), “38.212 CR - Introduction of Rel-17 UE power saving enhancements”, RAN1#107bis-e
3. [R1-2200816](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107b-e/Docs/R1-2200816.zip), “38.213 CR - Introduction of Rel-17 UE power saving enhancements for NR”, RAN1#107bis-e
4. [R1-2200828](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107b-e/Docs/R1-2200828.zip), “38.214 CR - Introduction of Rel-17 UE power saving enhancements”, RAN1#107bis-e
5. [R1-2200700](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107b-e/Docs/R1-2200700.zip), “LS on updated Rel-17 NR higher-layers parameter list”, RAN1, RAN1#107bis-e

# History

1. R1-2007065 FL summary of potential extension(s) to Rel-16 DCI-based power saving adaptation during DRX ActiveTime RAN1#102-E Moderator (vivo)
2. R1-2007117 FL summary#2 of potential extension(s) to Rel-16 DCI-based power saving adaptation during DRX ActiveTime RAN1#102-E Moderator (vivo)
3. R1-2007225 FL summary#3 of potential extension(s) to Rel-16 DCI-based power saving adaptation during DRX ActiveTime RAN1#102-E Moderator (vivo)
4. R1-2007400 FL summary#4 of potential extension(s) to Rel-16 DCI-based power saving adaptation during DRX ActiveTime RAN1#102-E Moderator (vivo)
5. R1-2009501 FL summary#1 of power saving for Active Time RAN1#103-E Moderator (vivo)
6. R1-2009655 FL summary#2 of power saving for Active Time RAN1#103-E Moderator (vivo)
7. R1-2009656 FL summary#3 of power saving for Active Time RAN1#103-E Moderator (vivo)
8. R1-2009804 FL summary#4 of power saving for Active Time RAN1#103-E Moderator (vivo)
9. R1-2101893 FL summary#1 of power saving for Active Time RAN1#104-E Moderator (vivo)
10. R1-2101894 FL summary#2 of power saving for Active Time RAN1#104-E Moderator (vivo)
11. R1-2106040 FL summary#1 of power saving for Active Time RAN1#105-E Moderator (vivo)
12. R1-2106041 FL summary#2 of power saving for Active Time RAN1#105-E Moderator (vivo)
13. R1-2108224 FL summary#1 of power saving for Active Time RAN1#106-E Moderator (vivo)
14. R1-2108225 FL summary#2 of power saving for Active Time RAN1#106-E Moderator (vivo)
15. R1-2108386 FL summary#3 of power saving for Active Time RAN1#106-E Moderator (vivo)
16. R1-2108387 FL summary#4 of power saving for Active Time RAN1#106-E Moderator (vivo)
17. R1-2108620 FL summary#5 of power saving for Active Time RAN1#106-E Moderator (vivo)
18. R1-2110406 FL summary#1 of power saving for Active Time RAN1#106bis-E Moderator (vivo)
19. R1-2110407 FL summary#2 of power saving for Active Time RAN1#106bis-E Moderator (vivo)
20. R1-2110517 FL summary#3 of power saving for Active Time RAN1#106bis-E Moderator (vivo)
21. R1-2110518 FL summary#4 of power saving for Active Time RAN1#106bis-E Moderator (vivo)
22. R1-2112578 FL summary#1 of DCI-based power saving adaptation RAN1#107-E Moderator (vivo)
23. R1-2112579 FL summary#2 of DCI-based power saving adaptation RAN1#107-E Moderator (vivo)
24. R1-2112769 FL summary#3 of DCI-based power saving adaptation RAN1#107-E Moderator (vivo)
25. R1-2112878 Final FL summary of DCI-based power saving adaptation RAN1#107-E Moderator (vivo)
26. R1-2200696 FL summary#1 of DCI-based power saving adaptation RAN1#107bis-E Moderator (vivo)
27. R1-2200697 FL summary#2 of DCI-based power saving adaptation RAN1#107bis-E Moderator (vivo)
28. R1-2200758 FL summary#3 of DCI-based power saving adaptation RAN1#107bis-E Moderator (vivo)