3GPP TSG RAN WG1#107-e R1-2112578

e-Meeting, Nov 11th – 19th, 2021

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#107-E.

* Section 2 is a list of the issues to be discussed/decided.
* Section 3 is void.
* 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: DCI and UE Behaviours

### Initial proposals

1. **Case 4 bit mapping**

Case4 bit mapping is not finalized in the last meeting. The following alternatives and observations are provided,

* + 2-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors,
    - Alt 1: *M* = 1 (Huawei/ HiSilicon, Samsung, Lenovo/MotM, MTK, ZTE/Sanechips)
      * ‘00’ is Beh 2
      * ‘01’ is Beh 2A
      * ‘10’ is Beh 1A (stay in current SSSG)
      * [‘11’ is reserved]
    - Alt 2: *M* = 1 (CMCC, DOCOMO, Qualcomm, Apple)
      * ‘00’ is Beh 2
      * ‘01’ is Beh 2A
      * ‘10’ is Beh 2 and Beh 1A
      * ‘11’ is Beh 2A and Beh 1A
    - Alt 3: *M* = 2 (DOCOMO, Qualcomm, Nordic(00/10/01/11 for the following behaviour))
      * ‘00’ is Beh 2
      * ‘01’ is Beh 2A
      * ‘10’ is Beh 2A and Beh 1A for duration T1
      * ‘11’ is Beh2A and Beh 1A for duration T2
    - Alt 3a: *M* = 2 (Huawei/ HiSilicon, CATT, Intel, Panasonic, Samsung, InterDigital, ETRI, Ericsson(10/11/00/01 for the following behaviour), MTK, Nokia/NSB, ZTE/Sanechips)
      * ‘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 )

Based on this, the following is proposed with some explanations below.

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| **[High] Proposal 1-1 (v1)**   * For Case 4 (i.e., 2 SSSG switching with PDCCH skipping) , the following is supported   + Alt a: (Alt 1 + Alt 3a)     - 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)   + Alt b: (Alt 2 + Alt 3):     - If *M* = 1, then       * ‘00’ is Beh 2       * ‘01’ is Beh 2A       * ‘10’ is Beh 2 and Beh 1A       * ‘11’ is Beh 2A and Beh 1A     - If *M* = 2, then       * ‘00’ is Beh 2       * ‘01’ is Beh 2A       * ‘10’ is Beh 2A and Beh 1A for duration T1       * ‘11’ is Beh2A and Beh 1A for duration T2   + Down-selection between Alt 1 and Alt 2 * Note: for ‘00’ and ‘01’, UE performs Beh 1(i.e., does not perform PDCCH skipping ) * Working assumption: By a single DCI indication, a UE is not expected to simultaneously perform two behaviors of SSSG switching and PDCCH skipping. * Note: The UE can be configured to be indicated by DCI a value of X (i.e., skipping duration) among *M* RRC configured values by scheduling DCIs indicating PDCCH schedules data |

Qualcomm commented some restriction for the PDCCH monitoring adaptation indication should be considered, such as

* Proposal 3: By a single DCI indication, a UE is not expected to simultaneously perform two behaviors of SSSG switching and PDCCH skipping.
* Proposal 4: The PDCCH skipping duration should be larger than the application delay of SSSG switching and no larger than the SSSG timer value.

Some reasons for selecting Alt a and Alt b from both side for example are as follows,

Alt a:

* For example, if currently active SSSG of a UE is SSSG0 and gNB intended to perform PDCCH skipping, Alt.3 can only support the PDCCH skipping indication meanwhile switching SSSG#1 simultaneously. Some companies proposed Alt 2 due to the benefit of “memoryless” for the active SSSG. However, if a DCI indicating SSSG switching is missed, the UE may not be able to receive the subsequent scheduling DCI due to the misalignment of SSSG. UE cannot receive DCI indicating “Beh 2 and Beh 1A” or “Beh 2A and Beh 1A”. The issue of SSSG miss-matching exists anyway, the benefit of Alt 2 is not valid. *[R1-2110840]*

Alt b:

* Alt 2 supports indication of skipping duration, and the state transition diagram is illustrated in Figure 2. Comparing the state transition diagrams of Alt 1 in Figure 1 and Alt 2 in Figure 2, respectively, it can be seen that they are functionally identical. Only their codepoint mappings are different. Unlike Alt 1, the codepoint mapping of Alt 2 is self-contained. That is, from a single DCI indication of Alt 2, the UE can identify both its current SSSG index and PDCCH skipping behavior without ambiguity. All the aforementioned issues with Alt 1 are not relevant to Alt 2. Therefore, Alt 2 is preferred to Alt 1 as a candidate of the Case 4 scheme. *[R1-2112229]*

1. **Case 5**

* Support case 5:
  + OPPO, CMCC, Panasonic, Samsung, Lenovo/MotM, ETRI, Nokia/NSB, CATT
* Not support case 5:
  + Huawei/HiSilicon, ZTE/Sanechips, vivo, Apple

Related bit mapping for case 5 is as follows proposed by supporters for case 5.

* + 2-bit in scheduling DCI is supported to indicate PDCCH monitoring adaptation UE behaviors
    - Alt 1: (CATT, Samsung, Lenovo/MotM, ETRI, Nokia/NSB)
      * ‘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’ in Alt 1/Alt 2, UE does not perform PDCCH skipping (i.e., Beh 1)
  + FFS Timer behaviour

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| **[Medium] Proposal 1-2 (v1)**  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 )   + FFS Timer behaviour |

1. **Case 3**

LGE proposes the following for ’[11 reserved]’ to be as no indication

*Proposal 2: For the bit mapping of DCI indication PDCCH monitoring adaptation for case 3, ‘11’ is Beh 1 or ‘no indication’.*

* *SSSG switching timer is not affected by Beh 1.*

Panasonic thinks the state ‘11’ UE behaviour is RRC configurable

Considering in case 4 there is also a cocepoint for ’[11 reserved]’ in alt 1. And similar discussion could be happen for such case again. Moderator suggests to finalize it later.

1. **Support M=3 for case 1**

There is some discussion during the TS38.213 email discussion, whether for case 1, UE is support to be indicated a third PDCCH skipping duration. Based on the contributions received, the followings are collected,

* Support M = 3 for PDCCH-skipping with 2 bits indication
  + Spreadtrum, OPPO, Ericsson
* Support M = 2 for PDCCH-skipping with 2 bits indication
  + Nokia/NSB, Nordic

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| **[Medium] Proposal 1-4 (v1)**  Support M = 3 for PDCCH-skipping with 2 bits indication for PDCCH monitoring adaptation case 1. |

1. **New fields**

During the discussion of TS38.212, one open issue is that whether a new field or resuing the existing field for PDCCH monitoring adaptation indication. For example, Huawei suggests to *Use 2-bits new indication field in scheduling DCI formats, as that in draft CR of TS38.212, to indicate PDCCH monitoring occasion when only single cell is configured. [R1-2110840]*

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| **[Medium] Proposal 1-5 (v1)**  A new indication field in scheduling DCI is used for indicating PDCCH monitoring adaptation. |

1. **Configuration of DCI field per DCI format**

Serveral companies mentions a issue whether a separate configuration is needed for DCI format X\_1 and DCI format X\_2 or DL and UL w.r.t to DCI field of PDCCH monitoring adaptation indication. It is summarized as follows,

LGE (Yes)

* *Proposal 4: Bit mapping to the monitoring behavior and/or bit size of indication of monitoring adaptation can be differently configured for each DCI format.*
* *Proposal 5: 0, 1, and 2 bit indication of monitoring adaptation can be flexibly configured for DCI format x\_2.*

NEC (No)

* *Proposal 2: DCI format DCI 1-1, 0-1, 1-2 and 0-2 should support the same PDCCH monitoring adaptation configurations.*

Nordic (Yes)

* *Proposal-8: Presence of DCI field in DCI format X\_1 and X\_2 is separately configurable.*

Ericsson (Yes)

* *Proposal 11 Higher layers can configure the PDCCH monitoring adaptation indication bits to be present only in the DL scheduling DCI, UL scheduling DCI, or both DL scheduling DCI and UL scheduling DCI.*
* ***FL recommendations:*** consider the following proposals

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| **[Medium] Proposal 1-6 (v1)**  Bit mapping to the monitoring behavior and/or bit size of indication of monitoring adaptation can be differently configured for each DCI format   * FFS details |

1. **Other proposals**

Panasonic

* *Proposal: 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.*

### Companies views (1st round)

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| **Company** | **Comment** |
| CATT | Proposal 1-1(v1) – behavior a. UE should stay in the current SSSG and not perform SSSG switching when it receive PDCCH skipping indiction.  Proposal 1-2(v1) – We are OK with the proposal  Proposal 1-4 (v1) – We are OK with the proposal  Proposal 1-5(v1) – We are OK with the proposal  Proposal 1-6 (v1) – We are OK with the proposal |
| Samsung | On P1-1, OK with the proposal and we support Alt a. For Alt b, it doesn’t allow PDCCH skipping to be applied on SSSG#0, which doesn’t make sense to us.  On P1-2, support.  On P1-4, support.  On P1-5, support.  On P1-6, we don’t support it. The configuration of DCI field can be based on configured PDCCH skipping duration and SSSGs, which is common to all applicable DCI formats within the same DL BWP. So, we think they should be same. |
| Spreadtrum | **Proposal 1-2 (v1): we do not support case 5**  **Proposal 1-4 (v1): support** |
| Panasonic | On 1-1, we are supportive on Alt a.  In addition, to clarify our understanding, the proposed working assumption is compatible with Alt a without restriction but may restrict the state machine of Alt b?  On 1-2, we support.  On 1-4, we are okay.  On 1-5, we are okay.  On 1-6, we are okay. |
| Huawei, HiSilicon | For **[High] Proposal 1-1 (v1)**, we support Alt.a. Regarding the Alt. b, we are wondering whether it violates the confirmed working assumption that we have:  **Agreement**  **Confirm the four working assumptions (extracted from package 1)**  ……  Working assumption(extracted from package 1):  Indication of Beh 1A for current SSSG when two SSSG(s) are configured is supported  For [Medium] Proposal 1-2 (v1), we don’t see a strong reason to support Case5.  We are fine with Proposal 1-4 (v1).  We are fine with proposal 1-5 for single cell case. For multiple cell, it should be further discussed. |
| ZTE, Sanechips | Our views on case 4 are added (in red).  Proposal 1-1  A small typo, it should be “Down-selection between Alt ~~1~~ a and Alt ~~2~~ b” .  Alt a is preferred. If UE is expected to switch to the default SSSG (SSSG#0) after the PDCCH skipping duration ends, the miss-detection issue will be addressed.  For Alt b, the restrictions  (1)UE cannot be indicated with either “11” in SSSG 0, or “10” indication in SSSG1 due to the self-contained indication  (2)UE can be indicated with only one skipping duration in a particular SSSG.  With all these restrictions, PDCCH monitoring occasion will not be adapted better than alt 1 in different scenarios.  Proposal 1-2  The function of Beh 2B can be realized through Beh 1A. There is no need to configure UE with a duplicated function of both Beh 1A and Beh 2B at the same time. Therefore, \ case 5 is not supported.  Proposal 1-3  We support 3 PDCCH skipping durations in case 1 to achive more flexibility.  Proposal 1-4  We think it is simple to use new indication field. We support proposal 1-4. |
| DOCOMO | We are OK with Proposal 1-1/2/4/5(v1). |
| IDCC | We support Alta for proposal 1-1.  For proposal 1-1, we are wondering if we should add FFS that T1/T2 can be configured differently for each SSSG.  We are fine with the other proposals. |
| Panasonic | On 1-1, we are supportive on Alt b.  On 1-2, OK.  On 1-4, OK.  On 1-5, OK.  On 1-6, OK. |
| Nordic | For P1-1 Alt 3   * + Alt c:     - If *M* = 1, then       * ‘00’ is Beh 2       * ‘01’ is Beh 2A       * ‘10’ is Beh 2 and Beh 1A       * ‘11’ is Beh 2A and Beh 1A     - If *M* = 2, then       * ‘00’ is Beh 2       * ‘01’ is Beh 2A       * ‘10’ is Beh 2 and Beh 1A duration T1       * ‘11’ is Beh 2A and Beh 1A duration T2   P1-3 Do not support  P1-4 M=2 is sufficient  P1-5 Not sure what is intention here, what other field it should be if not new?  P1-6 Unecessary optimization, we do not support |
| Vivo | P 1-1: For Alt a, the skipping can be indicated when UE is either in SSSG#0 or #1, which is more flexible than Alt b. For the non-self-contained issue raise in Qualcomm’s contribution, we think since the indication is deliverd by scheduling DCI, soon or later the the gNB /UE can recover from this case.  P1-2: We are fine if majority supports case considering not too much specification burden to do so.  P1-4: we support 1-4 considering it can provide more flexibility.  P1-5: we support it. To Nordic, the intension is to address the comments from 38.212 Editor. The editor asked this question and think it is unclear.  P1-6: we can support this. However, some questions need to be clarified.   * Whether the configuration of bits can be different from DL and UL? or * Whetehr the configuration of bits can be different from DCI format X\_1 and X\_2   So far in the current descrioption of TS38.213, the bits in the DCI is configured according to the configuration of skipping duration and SSSG. to support the proposal, it means the configuration of skipping duration and SSSG need to be separately configured. |
| Nokai(1st round) | **[High] Proposal 1-1 (v1)**  First one question for my clarification; does the wording “(stay in current SSSG)” refers to the proposed working assumption that the is no simultaneous changes of SSSG and skipping due to DCI indication? We have not yet concluded the timer/duration interaction, thus I assume that will be discussed separately? I would propose to clarify e.g. that the timer based SSSG change will be discussed separately. E.g. FFS SSSG switching timer behaviour.  In addition, we probably do not need the last note as the duration selection is accounted above. This just introduces confusion that there would be another mechanism for this.   * ~~Note: The UE can be configured to be indicated by DCI a value of X (i.e., skipping duration) among~~ *~~M~~* ~~RRC configured values by scheduling DCIs indicating PDCCH schedules data~~   With the assumption that timer related behaviour is independent of this we would support Alt a.  **[Medium] Proposal 1-2 (v1)** We would support this (accounting the same question for the wording “(stay in current SSSG)”) We don’t see that Behv 1A and Behv 2B are equivalent.  **[Medium] Proposal 1-4 (v1)**  Firstly to clarify, I asked the question in last meeting GTW whether the proposed agreement (at the time) containing the mapping for M=3 would also imply that we would support configuration of M=3 or whether that would be discussed later (as we had proposals discussed in this context). Now I was given understanding that this was not case, and we could discuss the support of M=3 in next (current) meeting. Evidently, if the provided answer would have been different I would have proposed changes to the proposed agreement 😊.  My key question regarding the support of M=3 is that it increases UE complexity (and risk of having further division in UE capabilities) when with M=2 we can already achieve 3 different behaviours.  That being said, we are OK to take the majority view in this matter.  **[Medium] Proposal 1-5 (v1)**  This would appear the simplest approach. |
| LG | Regarding the Proposal 1-1, we are generally okay with the proposal as a compromise. However, it is questionable whether it is right to make a proposal including a down-selection considering the limited time.  We support Alt a because we believe that the loss of misalignment of SSSG is greater than the benefits of “memoryless”.  By the way, there are some typo.   * + Down-selection between Alt ~~1~~a and Alt ~~2~~b   We support the Proposal 1-4. More skipping durations can provide gNB control flexibility of monitoring adaptation.  We support the Proposal 1-6. |
| Ericsson1 | P1-1 : Support Alt a. The WA seems to be unnecessary if the codepoints are explicitly agreed. Can it be clarified which particular setting of case 4 is of concern here?  P1-2 : We do not see strong need to support this case.  P1-4 : Support M=3.  P1-5 : It needs to be clarified that this is for the “”at most 2 bit indication in self-scheduling DCI” case from following agreement from RAN1#105-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*   P1-6 : Support. |
| Intel | Support Alt a in Proposal 1-1.  Altb is not supported according to the following agreement:  Indication of Beh 1A **for current SSSG** when two SSSG(s) are configured is supported  P 1-2, do not support. No need to have 3 SSSG switching and also PDCCH skipping together, as it is understood that 3rd SSSG is used as empty SSSG  P 1-4, Support  P 1-5, Support  P 1-6, Support |
| MTK | **Proposal 1-1**  Support proposal 1-1 (Alt a is preferred).  **Proposal 1-2**  It seems that the mechanism of case 5 can be implemented by case 4. We suggest to finish case 4 first and deprioritize case 5.  **Proposal 1-4**  We prefer M=2. So far, we have are not found a scenrio needs multiple skipping durations.  **Proposal 1-5**  Support. |
| Qualcomm | Proposal 1-1:  We support Proposal 1-1, in particular, Alt b. As we discussed in our contribution, the codepoing mapping of Alt b is self-contained. That is, there is be no ambiguity in the expected power saving behavior (i.e., SSSG index and PDCCH skip duration) when a DCI indication is received, regardless of whether any former DCI indications are missed. This is important to prevent propagation of error caused by the DCI misdetection and to recover from the error.  It is also argued by some companies that, if a DCI indicating SSSG switching is missed, the UE may not be able to receive the subsequent scheduling DCI and, thus, the self-contained indication may not be useful. However, it is up to gNB to configure SSSGs so that the benefit of the self-cotainted indication is fully exploited. For example, SSSGs can be configured in a nested manner, e.g., SSSG#0 is a subset of SSSG#1. Thus, using a SS set common in both SSSGs, a self-contained DCI indication can be transmitted regardless of any misalignment of SSSG inde between the UE and gNB, and the DCI can help the UE recover from the misalignment.  Proposal 1-2:  Related to the discussion on Proposal 1-1, the current codepoint mapping for Case 5 is not self-contained. Thus, as a proponent of Alt b in Proposal 1-1, we are not supportive of Proposal 1-2.  Proposals 1-4, 1-5, and 1-6:  We are fine with the proposals. |

### Updated proposals(before Nov12 GTW session)

1. **Case 4 bit mapping**

Majority companies are OK to have Alt a. Adding the last 2 FFS and removing last sub-bullet to address comments from Nokia and IDCC. Also correct typo.

* Alt a (11): CATT, Samsung, Huawei/HiSilicon, ZTE/Sanechips, IDCC, vivo, Nokia/NSB, LG, Ericsson, Intel, MTK
* Alt b (1): Qualcomm
* Others: Nordic (Alt c)
* ***FL recommendation***: Considering vast majority support of Alt a, moderator suggest the following proposals,

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| **[High] Proposal 1-1 (v2)**   * For Case 4 (i.e., 2 SSSG switching with PDCCH skipping) , the following is supported   + ~~Alt a: (Alt 1 + Alt 3a)~~ 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)   + ~~Alt b: (Alt 2 + Alt 3):~~     - ~~If~~ *~~M~~* ~~= 1, then~~        * ~~‘00’ is Beh 2~~       * ~~‘01’ is Beh 2A~~       * ~~‘10’ is Beh 2 and Beh 1A~~       * ~~‘11’ is Beh 2A and Beh 1A~~     - ~~If~~ *~~M~~* ~~= 2, then~~        * ~~‘00’ is Beh 2~~       * ~~‘01’ is Beh 2A~~       * ~~‘10’ is Beh 2A and Beh 1A for duration T1~~       * ~~‘11’ is Beh2A and Beh 1A for duration T2~~   + ~~Down-selection between Alt 1 and Alt 2~~ * Note: for ‘00’ and ‘01’, UE performs Beh 1(i.e., does not perform PDCCH skipping ) * Working assumption: By a single DCI indication, a UE is not expected to simultaneously perform two behaviors of SSSG switching and PDCCH skipping. * ~~Note: The UE can be configured to be indicated by DCI a value of X (i.e., skipping duration) among~~ *~~M~~* ~~RRC configured values by scheduling DCIs indicating PDCCH schedules data~~ * FFS SSSG switching timer behavior * FFS: T1/T2 can be configured differently for each SSSG |

1. **Case 5**

* Support case 5:
  + OPPO, CMCC, Panasonic, Samsung, Lenovo/MotM, ETRI, Nokia/NSB, CATT, DOCOMO, IDCC
* Not support case 5:
  + Huawei/HiSilicon, ZTE/Sanechips, vivo, Apple, Spreadtrum,Ericsson, Intel, MediaTek

It seems no clear majority. ZTE think the function of Beh 2B can be realized through Beh 1A while Nokia thinks We don’t see that Behv 1A and Behv 2B are equivalent. Intel argued that it is understood that 3rd SSSG is used as empty SSSG, thus no need for case 5. The proposal is not changed.

* ***FL recommendation***: Considering the consensus can not be achived, moderator suggest companies to consider if they have a strong concerns not to support case 5.

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| **[Medium] Proposal 1-2 (v2)**  Case 5 (i.e., 3 SSSG switching and skipping) is not supported. |

1. **Case 3**

No further comments regarding the ’[11 reserved]’ in case 3 except Nordic think it should not be supported.

1. **Support M=3 for case 1**

Yes (M=3): CATT, Sasmung, Spreadtrum, Panasonic, Huawei, HiSilicon, ZTE, Sanechips, DOCOMO, IDCC, Panasonic, Vivo, LGE, Ericsson, Intel

No (M=2): Nordic, Nokia/NSB(OK with majority view), MediaTek

* ***FL recommendation***: Considering vast majority support of M=3, it is proposed as follows,

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| **[Medium] Proposal 1-4 (v1)**  Support M = 3 for PDCCH-skipping with 2 bits indication for PDCCH monitoring adaptation case 1. |

1. **New fields**

* ***FL recommendation***: No companies bject and it seems the proposal is stable with the following update to address Ericsson and Huawei’s comment

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| **[Medium] Proposal 1-5 (v2)**  The following agreement in RAN1#106-E is updated as follows,   * 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 |

1. **Configuration of DCI field per DCI format**

Serveral companies mentions a issue whether a separate configuration is needed for DCI format X\_1 and DCI format X\_2 or DL and UL w.r.t to DCI field of PDCCH monitoring adaptation indication.

Support: CATT, Panasonic, LG, Ericsson, Intel

No Support: Samsung, Nordic

* ***FL recommendation***: Considering many companies has interest to the proposal 1-6, moderator encourage companies to provide more specific and detaild proposals and also adrssing the following questions
* Whether the configuration of bits can be different from DL and UL? or
* Whetehr the configuration of bits can be different from DCI format X\_1 and X\_2

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| **[Medium] Proposal 1-6 (v1)**  Bit mapping to the monitoring behavior and/or bit size of indication of monitoring adaptation can be differently configured for each DCI format   * FFS details |

### Updated proposals(after Nov12 GTW session)

1. **Case 4 bit mapping**

* ***FL recommendation***: continue discussion the following proposals from the GTW session

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| **[High] Proposal 1-1 (v3)**   * 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     - 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 * FFS: T1/T2 can be configured differently for each SSSG |

1. **Case 5**

* Support case 5:
  + OPPO, CMCC, Panasonic, Samsung, Lenovo/MotM, ETRI, Nokia/NSB, CATT, DOCOMO, IDCC
* Not support case 5:
  + Huawei/HiSilicon, ZTE/Sanechips, vivo, Apple, Spreadtrum,Ericsson, Intel, MediaTek

It seems no clear majority. ZTE think the function of Beh 2B can be realized through Beh 1A while Nokia thinks We don’t see that Behv 1A and Behv 2B are equivalent. Intel argued that it is understood that 3rd SSSG is used as empty SSSG, thus no need for case 5. The proposal is not changed.

* ***FL recommendation***: Considering the consensus can not be achived, moderator suggest companies to consider if they have a strong concerns not to support case 5.

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| **[Medium] Proposal 1-2 (v2)**  Case 5 (i.e., 3 SSSG switching and skipping) is not supported. |

1. **Case 3**

No further comments regarding the ’[11 reserved]’ in case 3 except Nordic think it should not be supported.

1. **Support M=3 for case 1**

Yes (M=3): CATT, Sasmung, Spreadtrum, Panasonic, Huawei, HiSilicon, ZTE, Sanechips, DOCOMO, IDCC, Panasonic, Vivo, LGE, Ericsson, Intel

No (M=2): Nordic, Nokia/NSB(OK with majority view), MediaTek

* ***FL recommendation***: Considering vast majority support of M=3, it is proposed as follows,

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| **[Medium] Proposal 1-4 (v1)**  Support M = 3 for PDCCH-skipping with 2 bits indication for PDCCH monitoring adaptation case 1. |

1. **New fields**

* ***FL recommendation***: No companies bject and it seems the proposal is stable with the following update to address Ericsson and Huawei’s comment

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| **[Medium] Proposal 1-5 (v2)**  The following agreement in RAN1#106-E is updated as follows,   * 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 |

1. **Configuration of DCI field per DCI format**

Serveral companies mentions a issue whether a separate configuration is needed for DCI format X\_1 and DCI format X\_2 or DL and UL w.r.t to DCI field of PDCCH monitoring adaptation indication.

Support: CATT, Panasonic, LG, Ericsson, Intel

No Support: Samsung, Nordic

* ***FL recommendation***: Considering many companies has interest to the proposal 1-6, moderator encourage companies to provide more specific and detaild proposals and also adrssing the following questions
* Whether the configuration of bits can be different from DL and UL? or
* Whetehr the configuration of bits can be different from DCI format X\_1 and X\_2

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| **[Medium] Proposal 1-6 (v1)**  Bit mapping to the monitoring behavior and/or bit size of indication of monitoring adaptation can be differently configured for each DCI format   * FFS details |

### Companies views (2nd round)

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| **Company** | **Comment** |
| IDCC | We support proposal 1-1. We are also ok for removing the second FFS if there is concern about it since we have another proposal later. We are ok with the other proposals as well. |
| Qualcomm | **Proposal 1-1:**  We have a strong concern on Proposal 1-1. As we commented during the first round, we believe the self-containedness of the indication is very important for the robustness of the indication. In fact, in Rel-15 and Rel-16, all the DCI indications are already self-contained (e.g., BWP indicator, minimum applicable scheduling offset indicator, etc.) and, therefore, we think the same principle should go on in Rel-17.  Regarding vivo’s comment during the first round; although HARQ and SSSG timer already support recovery mechanisms from SSSG misalignment, it is much slower than the recovery by the self-contained DCI indication, which is almost immediate. Also, the HARQ and timer-based mechanisms would not differ much from those for BWP switching. Unless Rel-17 power saving provides faster adaptation and recovery compared to the legacy schemes, there may be little motivation to use it.  Regarding some companies’ comment that one of the mapping in Alt b only support PDCCH skipping in SSSG#1, not in SSSG#0; as we argued in our contribution, to maximize the power saving gain, we think that SSSG#0 (default SSSG) should be configured with very sparse PDCCH MOs. That is, when there is traffic inactivity, SSSG#0 is used to occasionally sense an arrival of the next data burst and to receive a DCI indication to switch to SSSG#1. Thus, the motivation for using PDCCH skipping in SSSG#0 is not well-justified.  Regarding the last FFS, we are not quite sure about the intention. Is the discussion for T1/T2 separately covered in Proposal 4-2?  If Alt b is still the minority in the second round, we are also okay to compromise with the following:   * + - If *M* = 1, then (first option of Alt b)       * ‘00’ is Beh 2       * ‘01’ is Beh 2A       * ‘10’ is Beh 2 and Beh 1A       * ‘11’ is Beh 2A and Beh 1A     - If *M* = 2, then (second option of Alt a)       * ‘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)   Since the first options of Alt a and Alt b are functionally identical, hopefully the above suggestion is agreeable to Alt a proponents.  **Proposal 1-2/1-4/1-5/1-6:** We are okay with the proposals. |
| Apple | We prefer Alt b. It is memoryless, also has clear timer reset behaviro as defined in R16. For Alt a, the timer reset behavior has to be discussed and defined for ‘10’ and ‘01’. The working assumption is for Alt b, which we also do not agree. If the default pattern is dense pattern, use one DCI to trigger skipping then start monitoring sparse SSSG is a useful feature for UE power saving. After skipping, there may still no traffic therefore monitoring a sparse SSSG is very helpful. This is particularly useful in case we do not have non-scheduling DCI enabled, so UE will not end up monitoring the dense pattern after skipping, without any traffic.  However, since this is the last meeting, we are open to compromise to Alt a based on majority view. In this case, the working assumption is not needed anymore, since Alt a can not indicate skipping/switching simutanously anyway.  Support Proposal 1-2(v2), 1-4(v1), 1-5(v2)  Proposal 1-6, need further understanding the benefit and details. Is the proposal to enable only a subset of DCI format for PDCCH adapation? Or configure different skipping value or SSSG per DCI? |
| ZTE, Sanechips | We support proposal 1-1(v3) without the FFS bullets. As to the first bullet, it has been considered in the following first agreement in RAN1#106bis. The second FFS corresponds to the second agreements copied as below. We don’t think we need to duplicate the discussion.   |  | | --- | | **Agreements in RAN1#106bis**   * FFS whether to restrict Skipping duration to be shorter than SSSG initial timer value | | **Agreement in RAN1#106bis**  **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. |   As to the robustness with the DCI codepoint mapping in the proposal 1-1, we think it can be improved by defining UE behavior after PDCCH skipping, for example, switch to SSSG#0. The issue commented by QC can be addressed.  We support proposal 1-2, 1-4, 1-5.  For proposal 1-6, the configuration for DCI format X\_1 and X\_2 can be different considering DCI format X\_2 is designed for ultra- reliability. However,we don’t think there is any need to distinguish DL and UL. |
| OPPO | We are fine for the updated proposal 1-1. The FFS part although is not fully supported, but OK to further discussed.  Case 5 did not have technical issue. And, since this is also up to implementation/capability, there is not valid reason to object Case 5.  If there is no good reason to object, Case 5 should be supported.  We support Proposal 1-4 (v1).  Proposal 1-5 (v2), we are netrual. |
| Nordic | 1-1: Alt-b is preference  Below one is fully compliant with past agreements, as it can indicate skipping for current group, plus indicates also current SSSG group which is more reliable.   * + - If *M* = 1, then (first option of Alt b)       * ‘00’ is Beh 2       * ‘01’ is Beh 2A       * ‘10’ is Beh 2 and Beh 1A       * ‘11’ is Beh 2A and Beh 1A   1-4/1-6 no change in opinion, still we do not support, both are non-essential optimisations |
| CATT | We are OK with the updated Proposal 1-1(v3), 1-2 (v2), 1-4(v1), 1-5(v2), 1-6(v1) |
| Panasonic | On 1-1, we are okay.  On 1-2, we do not see any major issue on supporting Case 5. If concern is from network side, it is configurable anyway which is unified design with Case 3. If concern is from UE side, we do not see the additional complexity compared with Case 4, which is already supported.  On 1-4/5/6, we support. |
| Ericsson2 | OK with moderator proposals 1-1,1-2,1-3,1-5.  For 1-6, we suggest below revision:  **[Medium] Proposal 1-6 (v1)-updated**  Bit mapping to the monitoring behavior and/or bit size of indication of monitoring adaptation ~~can be differently~~ are independently configured for each DCI format  FFS details |
| Lenovo/Motorola Mobility | Proposal 1-1: OK in principle. If the SSSG switching timer expires during PDCCH skipping, UE may switch to a default SSSG. Thus, we think it is better to remove “stay in current SSSG”.  Proposal 1-2: We are okay not to support 3 SSSG switching and skipping, if empty SSSG configuration is not allowed (i.e. empty SSSG configuration is not a valid configuration).  Proposal 1-5: OK  Proposal 1-6: In a given search space, monitoring configuration is applicable to both a DL DCI format and an UL DCI format. Does the proposal suggest a different active SSSG at a given time for a DL DCI format and an UL DCI format? |
| Samsung | OK for P1-1/2/4/5.  On P1-6: the bitmapping and bit size depend on the configured number of PDCCH skipping duration, e.g. M, and SSSGs. In our view, those configurations are common to all applicable DCI formats within the same DL BWP. So, we think same mapping and monitoring behavior is needed. |
| Intel | We are fine with updated Proposals 1-1(v3), 1-2 (v2), 1-4(v1), 1-5(v2), 1-6(v1) |
| LG | We support Proposal 1-1 with removing the second FFS that is duplicate of Proposal 4-2.  Regarding QC’s comment above, we think there should not be constraint such as SSSG#0 (default SSSG) is configured with very sparse PDCCH MOs. As in Rel-16 (NR-U), gNB can configure SSSGs as it wishes. The only common understanding about configuring SSSGs is that SSSG#0 is default SSSG. gNB can configure SSSG#0 (default SSSG) with dense PDCCH MOs or with sparse PDCCH MOs, taking into account the usual traffic for UEs.  Regarding Proposal 1-2, we don’t have strong view but we can make it clear. Conerns about mutual substitutability of Beh 1A and Beh 2B depend on the configuration of SSSG#2. As we checked in the last meeting, FL confirmed that there is no restriction that SSSG#2 should be either ‘empty’ or ‘dormant’. Therefore there is possibility that SSSG#2 can be configured to include some SS sets. In this case, Beh 2B cannot be substituted by Beh 1A.  We are okay with Proposal 1-4 and 1-5.  We support Proposal 1-6.  We consider each case can be differently configured for DCI formats respectively. For example, 2-bit indication in DCI format 1\_1 and 1-bit indication in DCI format 1\_2 are supported. case 4 is configured for DCI format 1\_1 and either 1-bit case 1 or case 2 is configured for DCI format 1\_2, if both switching and skipping are supported. Different cases configurations for UL/DL also be possible.  There is a statement for possible skipping duration in the agreement from the last meeting as follows:   * + 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   We can see there is no upper limit on the number of RRC configured skipping duration that can be indicated by scheduling DCIs. So, there is a pool of candidate skipping duration and gNB can pick some up to configure a case for each DCI format. For example, if the UE is RRC configured with skipping durations {X1, X2, X3, X4, X5}, 2-bit case 1 with X1, X2, and X3 is configured for one DCI format and case 4 with X4 and X5 is configured for another DCI format. Of course, it is also possible for duplicate values ​​to be configured for different DCI formats.Or, one case with different values is possibly configured for different DCI foramts. |
| CMCC | We are fine about the proposals. |
| DOCOMO | We prefer Alt b. At least, the following proposal should be considered since it has the robustness using the self-containedness of the indication and no wasted bits compared to Alt a (*M*=1), but if it is the minor opinion we can live with alt a.   * + - If *M* = 1, then (first option of Alt b)       * ‘00’ is Beh 2       * ‘01’ is Beh 2A       * ‘10’ is Beh 2 and Beh 1A       * ‘11’ is Beh 2A and Beh 1A |
| MTK | **Proposal 1-1**  The benefit is not clear by relating the timer to T1/T2, so we suggest to keep the original one. Also, for the sake of progress, less FFS is preferred.  **Proposal 1-2**  We do not support this proposal. Multiple SSSGs and PDCCH skipping may introduce the issue of configuration/interaction of multiple timers and PDCCH skipping. We suggest to focus on finishing the details of case 4 first.  **Proposal 1-4**  Actually, we have not found the scenario for M=3. We can compromise if majority support it.  **Proposal 1-5**  Support. |
| ETRI | Support Proposal 1-1. We are also OK with Qualcomm’s suggestion.  OK with Proposal 1-2.  Support Proposal 1-4 and 1-5. |
| Huawei, HiSilicon | **Proposal 1-1 (v3)**: we support the proposal in general. For the first FFS, we are fine to keep it for further discussion considering some companies commented on this. The second FFS is not needed considering it shall be discussed in another proposal.  **Proposal 1-2 (v2), Proposal 1-4 (v1), Proposal 1-5 (v2)**: we are OK.  **Proposal 1-6 (v1)**: We don’t see strong need for different configuration on monitoring behaviors for different DCI format. Propsoal 1-6 looks a optimization but may cause much standard work. Considering the limited time, we agree with Samsung that we don’t need to differentiate the mapping and bit numbers of the new filed for different DCI format. |

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

### Initial proposals

Opnions regarding whether monitoring type 0/1/1A/2 CSS is impacted by PDCCH monitoring adaptation are as follows,

Huawei

* *Proposal 13: 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 Type0/0A/1 or 2 PDCCH CSS is not affected by SSSG switching indication, but is affected by PDCCH skipping indication.*

vivo

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

Panasonic

* *Proposal 3: PDCCH scrambled by C-RNTI is monitored in Type 0/1/1A/2 CSS.*

MTK

* *Proposal 1: Monitoring PDCCH scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI for Type 0/1/1A/2 CSS in Beh 1A is not supported.*

LGE

* *kipping shut 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 candidate*

Monitor Type0/0A/1/2-PDCCH is not affected: vivo, Panasonic,

Monitor Type0/0A/1/2-PDCCH is affected: Huawei/HiSilicon(only PDCCH skipping affects), LGE, MediaTek

* ***FL recmmendations:*** during the last meeting discussion, majority companies thinks the monitoring is not impacted, moderator suggests to check the following proposals.

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| **[Medium] proposal 2-1 (v1)**  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 Type0/0A/1 or 2 PDCCH CSS is not affected by PDCCH monitoring adaptation. |

### Companies views (1st round)

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| **Company** | **Comment** |
| CATT | We are OK with the conclusion |
| Samsung | we support P2-1 |
| Spreadtrum | fine |
| Panasonic | We support this proposal. |
| ZTE, Sanechips | Support. We think it is okay to apply PDCCH skipping only in type 3 and USS. |
| DOCOMO | Generally fine with this prosposal. |
| IDCC | We support this proposal. |
| CMCC | Support |
| Nordic | No need re-agree again, we agreed that Adaptation applies only to USS and TYPE3 CSS |
| Vivo | Fine |
| Nokia(1st round) | We are OK with this proposal. |
| LG | We do not support the Proposal 2-1. If 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 Type0/0A/1 or 2 PDCCH CSS is not affected by PDCCH monitoring adaptation, the UE can be scheduled by DCI with CRC scrambled by C-RNTI although the UE is indicated to skip PDCCH. In other words, the UE still can be scheduled while Beh 1A is activated. We doubt that this behaviour of the UE can be called as PDCCH skipping. |
| Ericsson1 | 2-1 : OK |
| Intel | We think this will limit power saving to some extent. But we are OK to compromise if majority wants this |
| MTK | We do not support this proposal.  It is noticed that, during the skipping duration, network cannot schedule retransmissions. It is fine for UE to monitor PDCCH scrambled by others RNTI in Type 0/1/1A/2 CSS, such as SI-RNTI, P-RNTI, RA-RNTI, since the corresponding PDSCHs require no retransmission handling.  Thus, it is recommended that UE monitors C-RNTI, MCS-RNTI or CS-RNTI after the skipping duration to avoid additional retransmission issue during the skip duration. |

### Updated proposals(before Nov12 GTW session)

LGE and MediaTek do not support this proposal for the following reasons,

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| LG | We do not support the Proposal 2-1. If 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 Type0/0A/1 or 2 PDCCH CSS is not affected by PDCCH monitoring adaptation, the UE can be scheduled by DCI with CRC scrambled by C-RNTI although the UE is indicated to skip PDCCH. In other words, the UE still can be scheduled while Beh 1A is activated. We doubt that this behaviour of the UE can be called as PDCCH skipping. |
| MTK | We do not support this proposal.  It is noticed that, during the skipping duration, network cannot schedule retransmissions. It is fine for UE to monitor PDCCH scrambled by others RNTI in Type 0/1/1A/2 CSS, such as SI-RNTI, P-RNTI, RA-RNTI, since the corresponding PDSCHs require no retransmission handling.  Thus, it is recommended that UE monitors C-RNTI, MCS-RNTI or CS-RNTI after the skipping duration to avoid additional retransmission issue during the skip duration. |

* ***FL recmmendations:*** suggest companies to provide their comments addressing LG and Mediatek’c concerns/questions

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| **[Medium] proposal 2-1 (v1)**  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 Type0/0A/1 or 2 PDCCH CSS is not affected by PDCCH monitoring adaptation. |

### Companies views (2nd round)

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| **Company** | **Comment** |
| IDCC | We support the proposal. |
| Apple | Support |
| ZTE, Sanechips | Support |
| OPPO | We suggest to have some different proposal, we have say all the PDCCH in Type0/0A/1 or 2 PDCCH CSS will not be skipped or switched off.  It seems also address MTK’s concern about the SI-RNTI, P-RNTI, RA-RNTI.  In general the ON-OFF seems should be for a search space set to save power, instead of certain RNTIs. |
| Nordic | Support. To address comments, monitoring Type0/0A/1/2 in RRC connected is rare, we do not see an issue for UE to monitor re-tx when Type0/0A/1/2 monitoring windows are due in RRC connected. |
| CATT | We Support the proposal |
| Panasonic | We support. |
| Ericsson2 | Support – the indicated adaptation applies only to USS and TYPE3 CSS. |
| Lenovo/Motorola Mobility | Support |
| Samsung | Support |
| Intel | Fine to support |
| LG | We do not support the proposal.  It seems like companies may have different understanding about this issue. It is an issue about monitoring with “C-RNTI” (and other RNTIs) in Type0/0A/1/2 CSS, not monitoring in Type0/0A/1/2 CSS itself. Monitoring Type0/0A/1/2 in RRC connected for original purpose (i.e. paging, SI request etc.) is not the point and we think it should be maintained as the legacy behavior. If we resue the current mechanism without modification, it is possible for gNB to schedule by C-RNTI through Type0/0A/1/2 CSS. |
| CMCC | Support |
| DOCOMO | Support |
| MTK | We agree with LG’s comment. It seems not reasonable for UE to monitoring C-RNTI during the skipping duration. Monitoring C-RNTI during the skip duration may cause the issue of retransmission handling. |
| ETRI | We support the proposal. |
| Huawei, HiSilicon | We share similar view with MTK and LG. We should take care of the power saving impact due to the monitoring of C-RNTI through Type0/0A/1/2 CSS.  Also, we think MTK raised a good point, if C-RNTI in Type0/0A/1/2 CSS is not impacted, retransmission may cause more issues.  We don’t support the proposal, but we are fine with the following revision:  **[Medium] proposal 2-1 (v1) revided by Huawei**  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 Type0/0A/1 or 2 PDCCH CSS is not affected by SSSG switching~~PDCCH monitoring adaptation~~, and is affected by PDCCH skipping. |

## Issues#3: SSSG switching

### Initial proposals

1. **Values for SSSG switching timers**

In the last meeting, the WA is agreed for the values for SSSG switching timers as follows,

**Agreement (email approval)**

-         The value of the SSSG switching timer in slots for SSSG#1 and/or SSSG#2 can be configured as

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

1. {[1…40, 80,100,160,200]} for 30 kHz SCS,
2. {[1…80, 160,200,320,400]} for 60kHz SCS,
3. {[1…160,320,400,640,800]} for 120kHz SCS

Huawei/HiSilicon, Ericsson thinks the WA can be confirmed.

Vivo thinks some of the values to be aligned with the DRX settings, e.g., inactivity timer, is preferred. It is proposed as follows (the change is marked red),

* 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…20,30, 40, 50, 60, 80, 100} for 15 kHz SCS,
* {1…40, 60, 80, 100, 100,160,200} for 30 kHz SCS,
* {1…80, 120, 160, 200, 240, 320,400} for 60kHz SCS,
* {1…160, 240, 320,400, 480, 640,800} for 120kHz SCS

Nokia thinks *If the signalling field size is to be reduced for SSSG switching timer, we could consider increase the granularity for the lower range e.g. to slot values corresponding to {[1, 2, 4, 5, 8, 10, 14, 15, 16, 20], 40, 60, 80, 100}ms.* The proposals are as follows,

Proposal: Support configuring skipping duration as a function of slots. The range could be defined as follows:

* {1,2,3,4,5,8,10,12,15,20} slots for 15kHz
* {1,2,4,8,10,12,16,20,30,40} slots for 30kHz
* {1,2,4,8,10,16,20,30,40,80} slots for 60kHz
* {2,4,8,10,16,20,30,40,60,80} slots for 120kHz
* ***FL recommendation:*** Consider supporting the following values (all proposed values)

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| **[High] Proposal 3-1 (v1)**  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…20,30, 40, 50, 60, 80, 100} for 15 kHz SCS, * {1…40, 60, 80, 100, 100,160,200} for 30 kHz SCS, * {1…80, 120, 160, 200, 240, 320,400} for 60kHz SCS, * {1…160, 240, 320,400, 480, 640,800} for 120kHz SCS |

1. **Configuration of SSSG switching timers**

In the last meeting, the following 3 alternatives are proposed for discussion. Based on the contributions, the following are observed.

* Alt 1: Separate RRC configuration for initial timer value(s) is supported for switching from SSSG#2 to SSSG#0 and from SSSG#1 to SSSG#0 respectively.
  + Supported by vivo, Ericsson, Qualcomm, Nordic, Fraunhofer HHI/ Fraunhofer IIS, Apple
* 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.
  + Supported by Huawei/HiSilicon, NEC
* 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.
  + Supported by Huawei/HiSilicon, ZTE/Sanechips, Intel, ETRI, MediaTek

Reasons for supporting Alt 1

* To give better flexibility to the NW, having one switching timer per non-default SSSG can be supported. The NW may exploit not only the SS periodicity, but also the switching timers for the purpose of UE power saving. For example, the NW may configure the UE with SSSG1 and SSSG2 having the same SSs and only differ in timer. The NW may then command the UE to switch to either SSSG1 or SSSG2 based on the expected interval between the data burst. [R1-2112152]
* For example, if PDCCH monitoring for SSSG#2 is very dense and SSSG#1 is very sparse, configuring a small value of timer for SSSG#2 to SSSG#0 and a large value for SSSG#1 to SSSG#0 is more appropriate from power saving perspective. [R1-2111026]
* Ambiguity caused by different initial timer values for non-default SSSGs can be handled by gNB implementation, for example by [R1-2112381]
  + Configuring SSSGs with nested Monitoring occasions (Mos)
  + Depending on ACK/NACK transmitting re-tx-PDCCH to a MO common to both non-default SSSGs
* ***FL recommendation:*** Further considering Alt 1 and Alt 3 by considering the above reasons

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| **[High] Proposal 3-2 (v1)**  **Downselect between the following two alternatives**  -         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 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. |

1. **Reset/decrement SSSG timer**

During the discussion of TS38.213, Editor provides a draft of the UE behavior for reset/decrement SSSG timer, companies are encouraged to provide comments to the followings.

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| **[High] Proposal 3-3 (v1)**  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 the Type3-PDCCH CSS set or the USS set with group index of either 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 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. |

1. **Timer from non-default SSSG to non-default SSSG switching**

Apple thinks switching from non-default SSSG (i.e., SSSG#2) to non-default SSSG (i.e., SSSG#1) has some merits. The proposals are as follows,

*Proposal 3: In case 3 when Beh 2/2A/2B are signaled in one DCI, and Beh 2B is used to emulate PDCCH skipping,*

* *Beh 2B can be triggered from either default SSSG, or non-default SSSG.*
* *Different timer can be configured per non-default SSSG when 3 SSSGs are enabled.*
* *When empty SSSG2 is triggered from non-default SSSG 1, freeze timer 1 of SSSG1 and start counting down of timer 2. When timer 2 expires, fall back to SSSG 1.*

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| **[Medium] Proposal 3-4 (v1)**   * When UE is in SSSG#2, UE fallbacks to SSSG#1 after SSSG timer expiration is supported.   + FFS details |

1. **Signaling of ‘empty/dormant’ SSSG**

Apple pointed out when 3 SSSGs are configured, SSSG2 is associated with empty SS set.

### Companies views (1st round)

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| **Company** | **Comment** |
| CATT | Proposal 3-1(v1) – We don’t agree to update the timer values. The values agree in RAN1#106b-e should be sufficient.  Proposal 3-2(v1) – Alt 3. There is no need for different timer between SSSG enerally  Proposal 3-3(v1) – The draft text by editor is OK  Proposal 3-4(v1) – We don’t see the need of this proposal. Fall back to default SSSG#0 should be sufficient. |
| Samsung | On P3-1, OK with the updated proposal, but also fine to confirm the original WA.  On P3-2, we support Alt3. gNB has enough flexibility to trigger switching among all configured SSSGs based on explicit indication in the DCI.  On P3-3, application delay should be considered to determine the start of the timer. So we suggest the following revision.  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, if running, 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 the Type3-PDCCH CSS set or the USS set with group index of either 1 or 2  - resets the timer after the application delay from 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  When the timer expires, the UE monitors PDCCH on the serving cell according to search space sets with group index 0.  On P3-4, we don’t support it. Dynamic triggered switching between non-fallback SSSGs is sufficient. |
| Panasonic | On 3-1, we would like to understand the motivation and technical merit on adding the values same with Inactivity timer in DRX.  On 3-2, we support Alt1.  On 3-3, does it mean the decrement and reseting of the timer is not impacted by the PDCCH monitoring for a search space not configured with any group ID? Because this is our understanding that such search space monitoring is not impacted by the SSSG switching. When timer expires, if PDCCH skipping duration is not finished, UE shall continue skipping PDCCH monitoring.  On 3-4, we do not support to complicate the design by two step fallback. |
| Huawei, HiSilicon | **[High] Proposal 3-1 (v1):** we are in enerally fine with it.  **[High] Proposal 3-2 (v1):** we prefer Alt.3. we think the only usage of the timer is to handle the misalignment between gNB and UE due to miss-detection/false-detection of the scheduling DCI.  **[High] Proposal 3-3 (v1):** Considering the timer is used to handle the misalignment between gNB and UE We support the description regarding timer decrements and resets, which seems similar as NR-U.  Rgardign Moderater’s question, firstly we don’t think we should support empty SSSG which is also not agreed yet.  If the UE is performing PDCCH skipping, when the timer expires, the UE should continue skipping PDCCH in the skipping duration. Therefore, the description of “When the timer expires, the UE monitors PDCCH on the serving cell according to search space sets with group index 0” in the current proposal seems UE stop the skipping behavior. Therefore, we propose the following revisions as an example:  *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 after the duration on the serving cell according to search space sets with group index 0.*   We don’t think proposal 3-4 should be supported. The default SSSG should be only SSSG#0. |
| ZTE, Sanechips | Proposal 3-1:  We are okay cofirm the WA with or without the new values.  Proposal 3-2:  We support Alt3. We think common timer which is configured per-BWP is sufficient. We think this proposal has impact on RRC parameter and it is better to down select one from the alternatives. And for Alt1, it is unclear the whether timer is configured per-BWP/cell or not. More clarification is needed further.  Proposal 3-3:  We think the timer can be reset when UE switches to SSSG#1 or SSSG#2, or UE detect a DCI in SSSG#1 or SSSG#2.  And decrement the timer after a slot of an active DL BWP of the serving cell.  Proposal 3-4  Not support. For SSSG#1 and SSSG #2, when SSSG timer expires, it is unnecessary for the UE to switch back to a different SSSG. We think that UE should fallbacks to SSSG#0 after SSSG timer expiration no matter UE is in SSSG#1 or SSSG#2. |
| IDCC | For proposal 3-2, we support Alt 1, RRC configuration for each SSSG.  We are ok with the other proposals. We agree with Apple that falling back to non-default SSSG has some merits. The SSSG to which to fall back can be configured. |
| CMCC | Proposal 3-1(v1) :Ok  Proposal 3-2(v1) :Prefer Alt 3.  Proposal 3-3(v1) :OK  Proposal 3-4(v1) : Prefer fall back to default SSSG#0. |
| Nordic | 3-1 OK  3-2 Alt 1 and per BWP. Timers shall be different, because periodicity of SSSG1 and SSSG2 are different.  3-3  Text for the case when only single timer is supported.  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 the Type3-PDCCH CSS set or the USS set ~~with group index of either 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 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.  3-4 Do not support |
| Vivo | P 3-1, we prefer the updated proposal  P 3-2, Alt 1 is preferred. We do not see problems to support it and it provides flexibility. |
| Nokia(1st round) | **[High] Proposal 3-1 (v1)**  We are fine to confirm the WA with or without the additional values.  **[High] Proposal 3-2 (v1)**  For Alt1, it is not fully clear whether the configuration of the timers would be per cell or per BWP? We are fine to support Alt1 with the assumption that the configuration can be provided per BWP. If not, then we would prefer Alt3.  **[High] Proposal 3-3 (v1)**  For the timer reset/decrement and for PDCCH reception in Type3-PDCCH CSS set we should also reset the timer only if we detect a DCI format carrying group index of either 1 or 2. Of course currently we don’t have any GC-PDCCH carrying the groupd index, but not sure if the timer should be resetted for any G-PDCCH.  For the timer reset and USS, it would be possible to configure DCI format 0\_0 and 1\_0 to USS, thus to keep choise for the network, it could also be considered that the timer is reset upon dection of DCI format 0\_0 or 1\_0 (which do not carry the PDCCH monitoring adaptation field).  If SSSG switching timer expires during the skipping duration, UE could continue the skipping, till end of skipping duration. Thus some adjustement of the wording could be considered once we have agreed the UE behaviour when SSSG switching is configured and skipping duration expires. In related note, that we proposed that also upon expiry of the skipping duration UE would change to SSSG#0.  **[Medium] Proposal 3-4 (v1)**  Tend to agree that for sake of simplicity, switching to SSSG#0 could be assumed.  On point 5), while tend to agree that {empty} SSSG could be one possible configuration, this is not mandated for SSSG#2 in my understanding. |
| LG | We are okay with the Proposal 3-1, 3-2, and 3-3. However, as already commented in Issue#1, it is questionable whether downselection is right or not at this point.  As we mentioned in our contribution, we should discuss the case that SSSG switching timer is not configured for the SSSG where no SS set is associated. As a solution, we proposed that a timer should be configured for the SSSG where no SS set is associated, or default timer that can be used when a UE is indicated to switch to SSSG with no timer configured is introduced. |
| Ericsson1 | 3-1 : Support.  3-2 : Support Alt 1. (Alt2 is subset of Alt 1).  3-3 : Our preference is “ timer resets/decrements based on detection/non-detection of scheduling DCI i.e. PDCCH with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI”. For timer expiry, OK with UE switching to SSSG0.  3-4 : No – switching to default SSSG0 is enough. |
| Intel | P 3-1, suggest to follow RAN1 106b agreement  P 3-2, Support Alt3  P 3-3, OK  P 3-4, Do not support |
| MTK | **Proposal 3-1, 3-3**  We are fine with these proposals.  **Proposal 3-2**  We support Alt 3. In our view, the behavior of PDCCH monitoring is mainly changed by DCI, and the timer is used for error-handling. If the intention of Alt 1 is to configure different timers for emulating different skipping durations, we suggest to use the configuration of skipping, such as case 1 or case 4.  **Proposal 3-4**  To simplify the SSSG switching state machine, we suggest UE switches to SSSG#0 (or the default SSSG) after SSSG timer expires. |
| Qualcomm | Proposals 3-1 and 3-2: We support the proposals.  Proposal 3-3:  In our view, the draft includes some redundant descriptions and could be cleaned up:  **[High] Proposal 3-3 (v1)**  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 the Type3-PDCCH CSS set or the USS set with group index of either 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 the Type3-PDCCH CSS set or the USS set with group index of either 1 or 2  - otherwise, decrement the timer value by one after each slot  When the timer expires, the UE monitors PDCCH on the serving cell according to search space sets with group index 0. |

### Updated proposals(before Nov12 GTW session)

1. **Values for SSSG switching timers**

Intel and CATT suggest to follow the values in [] as suggested from RAN1#106bis. While others are OK with the new values.

* ***FL recommendation:*** Consider supporting the following values

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| **[High] Proposal 3-1 (v1)**  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…20,30, 40, 50, 60, 80, 100} for 15 kHz SCS, * {1…40, 60, 80, 100, 100,160,200} for 30 kHz SCS, * {1…80, 120, 160, 200, 240, 320,400} for 60kHz SCS, * {1…160, 240, 320,400, 480, 640,800} for 120kHz SCS |

1. **Configuration of SSSG switching timers**

Alt1 is modified as follows to address the comment from Nokia. The observations are as follows,

Alt 1: (Panasonic, IDCC, Nordic, vivo, Nokia/NSB, Ercisson)

* The timer value(s) are configured per BWP and 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 3: (CATT, Samsung, Huawei/HiSilicon, ZTE/Sanechips, CMCC, Intel, MediaTek)

* 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.
* ***FL recommendation:*** Consdiering by agreeing Alt 1, it does not preclude Alt 3, moderator suggests companies to check if there are problems for agreeing Alt 1. Otherwise, Alt 3 is suggested.

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| **[High] Proposal 3-2 (v2)**  **Downselect between the following two alternatives**  -         Alt 1: The timer value(s) are configured per BWP and 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 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. |

1. **Reset/decrement SSSG timer**

Some modification based on the comments received as follows,

* Samsung:
  + For adding ‘in running’, I think it has been already included in the main bullet.
  + for the reset of time after the application delay, I think so far the application delay for SSSG switching is not agreed, so we need to wait for the agreement
* Nordic:
  + Accept the change and adding alternatives 1b/2b
* Nokia: adding alternatives 1b/2b
* Ericsson: the proposal is added as Alt 1c/2c
* Huawei: the text in the paragraph is updated according to the comment.

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| **[High] Proposal 3-3 (v2)**  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 receptionin the slot   + Alt 1a: for the Type3-PDCCH CSS set or the USS set with group index of either 1 or 2   + Alt 1b: for the Type3-PDCCH CSS set or the USS set   + Alt 1c: with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI * resets the timer after [the application delay from] 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   + Alt 2b: for the Type3-PDCCH CSS set or the USS set   + Alt 2c: with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI   [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 after the duration on the serving cell according to search space sets with group index 0.   ] |

### Companies views (2nd round)

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| **Company** | **Comment** |
| IDCC | We support proposals 3-1 and 3-2. For proposal 3-3, we need further clarification and we can discuss it later. |
| Qualcomm | **Proposal 3-3:**  As we commented for Proposal 3-3 during the first round, the descriptions for ‘decrement’ and ‘reset’ cases are mostly redundant. In our view, the decrement should be done in all cases that the timer is not reset, i.e., 1) no DCI format is detected, or 2) there is no configured PDCCH Mos in the slot. Thus, it would be rewritten as:  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 receptionin the slot~~    + ~~Alt 1a: for the Type3-PDCCH CSS set or the USS set with group index of either 1 or 2~~   + ~~Alt 1b: for the Type3-PDCCH CSS set or the USS set~~   + ~~Alt 1c: with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI~~ * resets the timer after [the application delay from] 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   + Alt 2b: for the Type3-PDCCH CSS set or the USS set   + Alt 2c: with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI * otherwise, decrease the timer value by one after each slot.   Also, the last two bullets added, we think the related issue (i.e., whether to allow PDCCH skipping duration longer than SSSG timer) should be separately discussed before adding the bullets. |
| Apple | Proposal 3-1, OK.  Proposal 3-2: Need to clarify whether SSSG2 is empty or non-empty SSSG. In our understanding, SSSG2 is empty SSSG used to emulate the skipping behavior. However there is no explicit agreement on this. Under the assumption SSSG2 is empty, we support Alt 1. If SSSG2 can be non-empty SSSG, then we support Alt 3.  Proposal 3-3: for timer count down, there are 3 options:  1). We propose to freeze timer during skipping operation. In this case, timer and skipping value can be independently designed.  2) count down, and timer value has to be larger than skipping value by configuration.  3) count down, when timer expires, wait under skipping finished then fall back to SSSG0. This is equavilent to re-define timer = max(timer, skipping).  It seems proposal only capture (3), which is the least clear definition to us.  Proposal 3-4: Support. We think this is beneficial for UE power saving when the default SSSG is the dense pattern. This enables UE to monitor the sparse SSSG1 after skipping (SSSG2 is empty SSSG). |
| ZTE, Sanechips | Proposal 3-1:  We are okay confirm the WA with or without the new values.  Proposal 3-2:  We support Alt3. We think common timer which is configured per-BWP is sufficient.  Proposal 3-3:  As to the timer decrement, we agree with QC that except for the case that timer is started/restarted, the timer should be decremented by one after each slot.  As to the timer start/restart, we think it can be simplied by  Alt 2d: with an indication of the same group index  For clarification, does “[the application delay from]” is the same delay discussed in issue #5 or a delay of “one slot” to reset the timer?  As to the last two bullets, the current wording is kind of ambiguious. For example, if UE receives an indication of PDCCH skipping in another cell which is also overlapped with this slot, it seems UE needs to also perform skipping/(or the behavior is unclear) in this cell according the second sub-bullet.  Another alternative is that as it is proposed by MTK, if UE receives PDCCH skipping during a non-default SSSG, the timer can be stopped. And UE switches to SSSG#0 after PDCCH skipping duration. This alternative can resolve the mis-detection issue raised by QC. |
| OPPO | We are supporting Alt3 for Proposal 3-2 (v2). Different timer seems not needed. No justification.  Proposal 3-2 (v2), we wonder why should we define how timer decrement.  The reseting would be fine. But we should just indicate what DCI indication in that slot UE had received, it is not about SS type and RNTI type. |
| Nordic | 1) OK  2) We could be fine with Apple suggestion to restrict SSSG#2 to empty and adopt Alt 1  3)  We do not support below behaviour,  [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 after the duration on the serving cell according to search space sets with group index 0.   This error case can be avoided by resetting timer with these options   * + Alt 2b: for the Type3-PDCCH CSS set or the USS set   + Alt 2c: with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI |
| Panasonic | On 3-2, we support Alt 1.  On 3-3, we are okay and support Alt 1a/2a. Also some editorial typo may need to be fixed, which should be “If UE is provided with a timer value…”. |
| Ericsson2 | 3-1 : Support.  3-2 : Support – given RRC impact, suggest to down-select one during this meeting. OK to go with majority view.  3-3 : Prefer Alt 1c/2c. The square bracketed text could be omitted for now and discussed separately as it is relevant only for case 4, which itself is still under discussion. |
| Lenovo/Motorola Mobility | Proposal 3-2: We support Alt3, to reduce ambiguity due to missed DCI.  Proposal 3-3: Prefer QC’s updated version and support Alt 2b. OK with the last 2 bullets (the following modification is suggested for clarification)  - If the UE has been indicated skipping PDCCH monitoring for a duration overlapping in time with the slot, the UE starts to monitor PDCCH upon completion of PDCCH skipping for the duration on the serving cell according to search space sets with group index 0. |
| Samsung | On P3-1: OK.  On P3-2: OK, and support Alt3.  On P3-3: For the case when the timer expires in a slot, application delay of PDCCH skipping should also be considered. PDCCH skipping can be applied to current SSSG, which will be SSSG#0 in this case. No additional specifications are needed |
| Intel | Support Proposals 3-1, 3-2 (alt3), OK for 3-3 (also support QC’s version). Content in [ ] can be discussed later after progress on Case 4 |
| LG | We are okay with Proposal 3-1 and 3-2.  According to Proposal 3-3, a timer is reset when UE detects a DCI format in a PDCCH reception. However, there is a situation that monitoring adaptation field in received DCI is [‘11’ is reserved] for the case 4 (M=1) in Proposal 1-1(v3). In this case, we think a timer should not be reset and just be decremented. Thus we suggest to reflect this behavior to proposal 1-1(v3).  Apart from other proposals, we would like to raise a concern about a timer for ‘empty’ SSSG. In the Porposal 3-3, there are only UE’s behavior when SSSG timer is configured. As agreed in the last meeting, timer can be optionally configured as in Rel-16. Which means there is the case when timer is not configured. In this case in Rel-16, a UE can only be switched by detecting DCI without setting timer. Consequently, in Rel-17 SSSG switching for power saving, a UE can only be switched by detecting DCI and a UE monitors SS sets associated with current SSSG if there is no configured timer. However, the ‘empty’ SSSG is not precluded thus it is possible that a UE is provided SSSG#2 associated with no SS set and SSSG timer is not configured simultaneously. In this case, if a UE is indiacted to switch to the ‘empty’ SSSG, a UE should stay on the ‘empty’ SSSG until the current DRX cycle is over.  As a solution, we proposed that a timer should be configured for the SSSG where no SS set is associated, or default timer that can be used when a UE is indicated to switch to SSSG with no timer configured is introduced. |
| CMCC | Proposal 3-1: Ok  Proposal 3-2: Our preference is Alt 3 but can also follow majority view.  Proposal 3-3: Prefer 1b/2b, in addition, we don’t know why to introuduce the application delay when reset timer? If the application delay is used for decoding DCI, whether UE doesn’t need it when decrements the timer? |
| MTK | **Proposal 3-1**  Support.  **Proposal 3-2**  We prefer Alt 3, but we are also fine with Alt 1.  **Proposal 3-3**  We suggest to remove application delay to avoid different expiration time.   * resets the timer after ~~[the application delay from]~~ 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   In the legacy behavior, UE resets the timer if it detects a DCI format. It is preferred to have a consistency behavior. In addition, we have not determined whether the application delay depends on the retransmission handling. To avoid different expiration time caused by different application delay, we suggest UE to reset the timer when detecting the indication of PDCCH adaptation.  For the second paragram, we suggest to simplify the statement.  UE switches to the default SSSG (SSSG 0) when it receives the indication of PDCCH skipping.  That is, no matter whether the skipping duration is overlapping with the time of SSSG switching, UE starts to monitor PDCCH on the serving cell according to search space sets with group index 0 after the skipping duration. |
| ETRI | OK with Proposal 3-1.  For Proposal 3-2, we prefer Alt-3.  For Proposal 3-3, we prefer QC’s update. For the last two bullets, we share the view with Apple that more options can be discussed. |
| Huawei, HiSiicon | **Proposal 3-1 (v1)**: we are generally fine. However, can we clarify first how to interpret the “……” in the value candidates? Let’ s make them clear.  **Proposal 3-2 (v2)**: We support Alt 3. Still we don’t think Alt.1 is needed.  **Proposal 3-3 (v2)**: We are OK with Qualcomm’s modification on decrement part, which seems more clear. We think the motivation of the timer is to guarantee the aligned understanding of currently used SSSG between gNB and UE. If Alt2b is adopted, and if a DCI is transmitted in a USS not belonging to any configured SSSG, this DCI cannot help to align the understanding currently used SSSG. Therefore, in this case, the timer should not be reset. Alt 2c means only scheduling DCI can affect the timer, which restricts the possibility to reflect the currently used SSSG by other DCI format, e.g. DCI format 2\_x. Considering this, we prefer Alt.2a.  For the comment from Samsung’s and Lenovo’s comment regarding the application delay for timer expires, we are fine for Lenovo’s revision. For ZTE’s comment, in our understanding all the description is focusing on the same cell. We don’t want to make PDCCH skipping and SSSG switching combined or impacted each other too much, which may cause UE complexity.  Some comments to Nordic’s comment, we don’t think they are error cases for the last two bullets in the square brackets. |

## Issues#4: PDCCH skipping duration

### Initial proposals

1. **Possible values for skipping durations**
2. Some companies [Intel, LGE] think the skipping duration larger than 20ms is needed.For example,
   * Intel[4ms, 8ms, 16ms, 32ms, 64ms],
   * LGE[{1…20, 40, 60, 80, 100ms} that are aligned with switching timer]
3. Apple and vivo propose to include skip current DRX. While some companies think it is not nessasry to include possibility to skip current DRX if DRX is configured, it can be achived by MAC CE.
   * Reason to include next DRX cycle
     1. [R1-2111886]*For case 1,* when 2 bits are used to indicate different skipping step size, it is beneficial to support the RRC configuration for skipping until next DRX cycle. Skipping until the next DRX cycle was evaluated for PDCCH skipping and has shown the largest power saving gain. Comparing to MAC CE based approach, the DCI based approach is faster, therefore achieve better power saving benefit over MAC CE. It is up to the network to configure the exact skipping step size.
4. For the unit of skipping durations, the following proposals are observed,

* Slot: vivo, Huawei/HiSilicon, Ericsson(including half-slot), Nokia/NSB
* Monitoring periodicity: CATT
* ***FL recommendations***: Further check the following issues,
  + Skipping duration longer than 20ms
  + Skipping the current DRX when DRX is configured.
  + Unit of X

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| **[High] Proposal 4-1 (v1)**   * 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.       * FFS detail values   + FFS: Equal to or longer than the applicable minimum scheduling offset |

1. **Configuration of skipping duration**

* Per SSSG
  + Huawei/HiSilicon (SSSG is configured), InterDigital
* Per BWP
  + Huawei/HiSilicon (SSSG is not configured), Intel, CMCC, Samsung, Ericsson, Qualcomm, MediaTek, Nordic
* Per SSS
  + CATT states that skipping duration is not per BWP since different scheduling schemes (e.g., slot-based or mini-slot based scheduling) would require different skipping interval in an Active BWP. ***The PDCCH skipping is a specific behavior associated with a given Search Space set.***
* ***FL Recommendations*** : Considering majority interests

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| **[High] Proposal 4-2 (v1)**   * The *PDCCHSkippingDurationList-r17* is configured per BWP |

### Companies views (1st round)

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| **Company** | **Comment** |
| CATT | Proposal 4-1(v1) – We can NOT agree to have “slot “ as the unit of skipping duration The skipping duration should support slot-based and mini-slot based scheduling at a given search space. Moreover, the PDCCH monitoring periodicity for a given search space could be different among different search space. If the skipping duration with unit “slot”, UE could not skip PDCCH monitoring within a slot for mini-slot scheduling. In addition, UE could have conflict of skipping duration when two search space has different periodicity. For example, the skipping duration is 2 slots with slot as the unit of duration. How would one search space with 1 slot periodicity and the other search space with 4 slot periodicity interpret the skipping duration of 2 slots.  Proposal 4-2(v1) – We can NOT agree to have duration per BWP since it would not support different service (e.g., eMBB and URLLC) or scheduling scheme (slot and mini-slot scheduling) with different search space within a BWP. |
| Samsung | On P4-1, we prefer unit to be ms, so common applicable values can be considered for all DL BWPs. We are OK to consider skipping duration to be equal to applicable minimum scheduling offset. However, we think no explicit indication is needed for this case.  On P4-2, we support it |
| Spreadtrum | **Proposal 4-1 (v1): Fine**  **Proposal 4-2 (v1): Fine** |
| Panasonic | On 4-1, we are okay.  On 4-2, we are okay. |
| Huawei, HiSilicon | **[High] Proposal 4-1 (v1):** Although, we think up to 20ms length of PDCCH skipping is sufficient, however, it is fine for us if other companies prefer longer duration for PDCCH skipping.  **[High] Proposal 4-2 (v1):** We are OK to agree the main bullet, however, we think some bullet should be added to allow per SSSG skipping duration can be optionally configured which can override the per BWP configured one.  Also, we see some companies supporting per BWP configured skipping durations here proposed per SSSG based timer in proposal 3-2, and their argument in proposal 3-2 is better power saving gain when different timers are used for different SSSGs. To follow this logic, different skipping duration is also needed to be configured for better power saving gain.  To further explain our view, we think the timer for SSSG switching is used to fallback to the SSSG#0 to align the understanding between gNB and UE. So it should be per BWP configuered. However, here, the skipping durations are directly for power saving purpose. Therefore, we think per SSSG configured skipping durations need to be enabled.  We expect some technical discussion and clarification before we just simply use the majority view. |
| ZTE, Sanechips | Proposal 4-1  We are okay to support skipping duration up to 100ms. We think there is no need to restrict the skipping duration to be equal or larger than minK0/K2. Hence, we think the last bullet is not needed.  Proposal 4-2:  Support. We think the skipping duration should not be bundled with SSSG, which are two independent features. |
| IDCC | For proposal 4-2, we agree with Huawei that per SSSG configuration should be supported since each SSSG may serve traffic of different characteristics. We are ok with proposal 4-1. |
| CMCC | Support two proposals |
| Nordic | P4-1 Do not support skipping for up to 100ms, 20ms is sufficient  P4-2 OK, but values may be SSSG dependent |
| Vivo | P 4-1 we support Intel and LG proposal to make the skipping duration longer whichprovide flexibility  For the unit, upon detection of a PDCCH, UE may have ambiguity of which search space it belongs to if two Ssare overlapped in a slot. Hence, the monitoring period which associated to the SS is ambiguity.  For Samsung’c comment, because the skipping duration can be configured per BWP, so it’s not a problem to align the length between different BWPs even it is in the unit of slot.  P 4-2 we are supportive. |
| Nokia(1st round) | **[High] Proposal 4-1 (v1)**  We don’t see a need to support longer duration for skipping than 20ms (which is even long).  **[High] Proposal 4-2 (v1)**  We agree with the proposal. In case 4 we can indicate two different durations with DCI and with case 5 one, thus there would not seem to be any need to have SSSG specific timer configuration. Different services could be assigned in BWP specific manner to have different durations (e.g. T1 and T2). To further accommodate change in the overall “long term” traffic charasteristics, having BWP specific durations accompanied with BWP change would allow further adaptation.  In our view SSSG timer in our view is not only for the purpose of alignment, but with semi-predictable interarrival packet interarrival time the timer could be to allow reduced PDCCH monitoring for a duration, while limiting the latecy impact if packet arrival behaves in unexpected manner. |
| LG | Regarding the Proposal 4-1, we are okay and support to include skip the DRX cycle.  Regarding the Proposal 4-2, we don’t have strong view, but we somewhat agree CATT’s view that different skipping durations are needed for different services. |
| Ericsson1 | 4-1 : Support. To finalize RRC work, it would be good to us the same values as for SSSG timer.   * {1…20,30, 40, 50, 60, 80, 100} for 15 kHz SCS, * {1…40, 60, 80, 100, 100,160,200} for 30 kHz SCS, * {1…80, 120, 160, 200, 240, 320,400} for 60kHz SCS, * {1…160, 240, 320,400, 480, 640,800} for 120kHz SCS   4-2:Support. |
| Intel | Support both proposals |
| MTK | **Proposal 4-1**  In our view, 100ms is such a long duration for PDCCH skipping. In SSSG switching mechanism, UE still keeps monitoring PDCCH when SSSG timer is counting. We prefer 20ms as the maximum skipping value.  **Proposal 4-2**  Support. |

### Updated proposals(before Nov12 GTW session)

1. **Possible values for skipping durations**
2. Some companies [Intel, LGE] think the skipping duration larger than 20ms is needed.For example,
   * Intel[4ms, 8ms, 16ms, 32ms, 64ms],
   * LGE[{1…20, 40, 60, 80, 100ms} that are aligned with switching timer]

Support of longer than 20ms:Intel, LGE, HW/HiSi, ZTE/Sanechips, IDCC, CMCC, vivo, LG, Ericsson, Intel (10)

Not Support longer than 20ms: HW/HiSi, Nordic, Nokia/NSB, MediaTek (4)

1. Apple and vivo propose to include skip current DRX. While some companies think it is not nessasry to include possibility to skip current DRX if DRX is configured, it can be achived by MAC CE. LG also support.
   * Reason to include next DRX cycle
     1. [R1-2111886]*For case 1,* when 2 bits are used to indicate different skipping step size, it is beneficial to support the RRC configuration for skipping until next DRX cycle. Skipping until the next DRX cycle was evaluated for PDCCH skipping and has shown the largest power saving gain. Comparing to MAC CE based approach, the DCI based approach is faster, therefore achieve better power saving benefit over MAC CE. It is up to the network to configure the exact skipping step size.
2. For the unit of skipping durations, the following proposals are observed,

* Slot: (9)
  + vivo, Huawei/HiSilicon, Ericsson(including half-slot), Nokia/NSB, ZTE/Sanechips, IDCC, CMCC, Intel, Spreadtrum
* Monitoring periodicity: (1)
  + CATT
* ms: (1)
  + Samsung
* ***FL recommendations***:
  + Skipping duration longer than 20ms is majority, considering 20ms is a subset of 100ms, unless there is a problem, moderator suggest to agree this. Otherwise there is a problem, agree 20ms as upper bound.
  + 3 companies think skipping the current DRX when DRX is configured is needed.
  + Unit of X is per slot considering vast majority.

|  |
| --- |
| **[High] Proposal 4-1 (v1)**   * 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.       * FFS detail values   + FFS: Equal to or longer than the applicable minimum scheduling offset |

1. **Configuration of skipping duration**

Yes to Proposal 4-2(v1): Samsung, Spreadtrum, Panasonic, ZTE/Sanechips, CMCC, vivo, Nokia, Ericsson, Intel, MTK

No to Proposal 4-2(v1): CATT, Huawei/HiSilicon, IDCC, Nordic, LG

Both side has many companies supporting.the main issue is that whether we need different skipping durations are needed for different services by configuring the skipping duration per SSSG or per SSS

|  |
| --- |
| **[High] Proposal 4-2 (v2)**   * At lest when the SSSG switching is not configured, the *PDCCHSkippingDurationList-r17* is configured per BWP   + FFS when the SSSG switching is configured |

### Companies views (2nd round)

|  |  |
| --- | --- |
| **Company** | **Comment** |
| IDCC | We are ok with these proposals. For proposal 4-2, we prefer timer values are configured per SSSG. |
| Qualcomm | **Proposal 4-2**:  This issue is closely related to Proposal 1-1. If the DCI indication is self-contained (Alt b), there is no ambiguity in the SSSG index between UE and gNB, and thus per-SSSG skipping duration will work without any issue. However, if the DCI indication is not self-contained (Alt a), per-SSSG skipping duration makes the things worse in the UE-gNB misalignment situation.  Therefore, if we select Alt b in Proposal 1-1, we are okay with per-SSSG configuration. On the other hand, if we go with Alt a in Proposal 1-1, we support per-BWP configuration. |
| Apple | Proposal 4-1, we can support the proposal. We would like to emphasize again that just one value indicating end of DRX cycle. It has minimum signaling overhead, can be one option when M=3 for case 1.  Proposal 4-2: Support. |
| ZTE, Sanechips | Proposal 4-1  We are okay to support skipping duration up to 100ms. We think there is no need to restrict the skipping duration to be equal or larger than minK0/K2. Hence, we think the last bullet is not needed.  Proposal 4-2:  We prefer the previous version (v1). We think the skipping duration should not be bundled with SSSG, which are two independent features. |
| OPPO | We are open for the skipping duration. 100ms is acceptable. Would be better to conclude the duration list, not only Max value.  Per BWP is acceptable for us. It acutually have not problem for per UE. We don’t expect BWP switching happen open.  Per SSSG is too much. |
| Nordic | 1. We could compromise to 100ms (even thought we do not see technical need for it), but at the same time, eNB should not configured SSSG timer value smaller than skipping value. With this restriction we can be fine with the proposal 2. In case of SSSG is configured, then at most one value per SSSG |
| CATT | We can NOT agree on Proposals 4-1(v1) and 4-2(v2). Since we had agree to have up to 2-bit PDCCH monitoring adaptation included in DCI formats 1\_1, 0\_1 (eMBB) and 0\_2, 1\_2 (URLLC). Proposals 4-1 and 4-2 would not allow to support PDCCH adaption for eMBB and URLLC when they are configured in the same BWP. |
| Panasonic | We are okay with 4-1/2. |
| Ericsson2 | 4-1 : Support. To finalize RRC work, it would be good to us the same values as for SSSG timer.   * {1...20,30, 40, 50, 60, 80, 100} for 15 kHz SCS, * {1...40, 60, 80, 100, 100,160,200} for 30 kHz SCS, * {1...80, 120, 160, 200, 240, 320,400} for 60kHz SCS, * {1...160, 240, 320,400, 480, 640,800} for 120kHz SCS   4-2: OK, but our preference is per-BWP even when SSSG are configured (i.e. for case 4). |
| Lenovo/Motorola Mobility | Proposal 4-1: OK  Proposal 4-2: OK |
| Samsung | OK for 4-1/2. |
| Intel | Support both proposals. Agree with Apple to include “indication of entering DRX OFF” as one value. For M =3, it should be possible and adds more flexibility |
| LG | We are okay with Proposal 4-1.  Regarding Proposal 4-2, our preference is not properly reflected in the previous round. As commented in 2.1.5 (2nd round), even if skipping durations are RRC configured per BWP, different scenarios (e.g. eMBB and URLLC) can be handled. Therefore, we prefer per-BWP configuration regardless of SSSG switching configuration. |
| CMCC | Ok for both. |
| MTK | **Proposal 4-1**  We can compromise to support it.  **Proposal 4-2**  Fine with this proposal. |
| ETRI | OK with Proposal 4-1 and 4-2. |
| Huawei, HiSilicon | **Proposal 4-1 (v1)**: OK. However, it would be better to have more progress on the detailed round. We propose to have better granualarity for smaller skipping durations. An example could be:   * {1... 2, 4, 8, 20, 40, 60, 80, 100} for 15 kHz SCS, * {1... 4 ,8, 16, 40, 120,160,200} for 30 kHz SCS, * {1... 8, 16, 32,80,240,320,400} for 60kHz SCS, * {1... 16, 32,64,160,480,640,800} for 120kHz SCS   **Proposal 4-2 (v2)**: OK. Regarding Qualcomm’s concern, if a DCI indicating SSSG swithcing is missed by the UE, the UE may even cannot receive the follow-up indications at all. So we don’t think per SSSG configured skipping duration makes the things worse in the UE-gNB misalignment situation than per BWP configured skipping duration. |

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

### Initial proposals

In the last meeting, a list of options is agreed as the candidate options for application delay. From the contributions, many companies mentioned the application delay can be related to other procedures such as retransmission. Also, when a SSSG timer expired, an application delay may also needed for group switching.

The proposals for application delay are thereby categorized and summarized as follows,

* Downlink and uplink grant
* SSSG switching and PDCCH skipping

**Table 1: proposals for application delay for PDCCH monitoring adaptation**

|  |  |  |  |
| --- | --- | --- | --- |
| Category | | **Application delay (the time for applying the indication)** | **Conditions for stop/suspend/not apply/cancel the indication** |
| PDCCH skipping | DL grant | Option d: (Apple, ZTE/Sanechips, ETRI, LGE, MediaTek, Nokia/NSB)   * 1 slot after the last OFDM symbol of ACK transmission. (Apple) * After the last OFDM symbol of ACK transmission (ZTE(option1)) * (ETRI, LGE, MediaTek) * skipping is not applied until successful decoding or UL transmissions are not pending (Nokia/NSB) | If the UE fails to decode the associated PDSCH and/or transmit a NACK, the PDCCH skipping does not apply. |
| **Option b: (Huawei/HiSilicon, ZTE, Intel, DOCOMO)**   * *Max(applicable K0min, Z)* after the last OFDM symbol of PDCCH (Huawei/HiSilicon) * Reuse the application delay for K0min/K2min indication if K0min/K2min is configured (ZTE) * (Intel, DOCOMO)   **Option i or Option f: (ZTE/Sanechips, vivo, NEC, CATT, InterDigital, Qualcomm, Nordic, Ericsson)**   * Zero or by implementation (ZTE(option 2), vivo, NEC, CATT, InterDigital, Qualcomm, Nordic) * For PDCCH-skipping via scheduling DCI format 1-1/1-2, UE applies the skipping immediately after the UE receives the indication (e.g. next symbol/slot) (Ericsson) | Option 1: If the UE fails to decode the associated PDSCH and/or transmit a NACK, Beh 1 is performed (i.e., the PDCCH skipping is stopped)  Option 2: If the *RetransmissionTimerDL* is running, the PDCCH skipping is not applied |
| UL grant | Option c: (Apple, ZTE/Sanechips, ETRI, LGE, Nokia/NSB)   * after the last OFDM symbol of PUSCH transmission if *drx-RetransmissionTimerUL* is not configured (Apple) * after the last OFDM symbol of PUSCH transmission (ZTE(option1)) * skipping is not applied until successful decoding or UL transmissions are not pending (Nokia/NSB) * (ETRI, LGE)   **Option g: (Ericsson)**   * [For PDCCH-skipping indicated via scheduling DCI format 0-1/0-2, UE applies the skipping command after an RRC configured delay expires. If the timer is not configured, the UE applies the PDCCH-skipping immediately.](#_Toc87041618) (Ericsson)   **Option h: (Apple, Lenovo/MotM, MediaTek)**   * after the *drx-RetransmissionTimerUL* expires if *drx-RetransmissionTimerUL* is configured (Apple, Lenovo/MotM, MediaTek)   **Option i or Option f: (ZTE/Sanechips, vivo, NEC, CATT, InterDigital, Qualcomm, Nordic, Ercisson)**   * Zero or by implementation (ZTE(option 2), vivo, NEC, CATT, InterDigital, Qualcomm, Nordic) * [For PDCCH-skipping indicated via scheduling DCI format 0-1/0-2, UE applies the skipping command after an RRC configured delay expires. If the timer is not configured, the UE applies the PDCCH-skipping immediately.](#_Toc87041618) (Ericsson)   **Option b: (ZTE/Sanechips, Intel, DOCOMO)**   * Reuse the application delay for K0min/K2min indication if K0min/K2min is configured (ZTE(option 2)) * (Intel, DOCOMO) | Option 1: N/A  Option 2: If the *RetransmissionTimerUL* is running, the PDCCH skipping is not applied |
| SSSG switching | DL grant | Option d: (Apple, Huawei/HiSilicon, ZTE/Sanechips, CATT, ETRI, LGE, Ericsson, MediaTek)   * 1 slot after the last OFDM symbol of ACK transmission. (Apple) * After the last OFDM symbol of ACK transmission (Huawei/HiSilicon, ZTE(option1)) * (CATT, ETRI, LGE, Ericsson, MediaTek) | If the UE fails to decode the associated PDSCH and/or transmit a NACK, The SSSG switching does not apply. |
| Option a: (ZTE/Sanechips, vivo, Intel, Nokia/NSB, Nordic, NEC, Qualcomm(modified))   * *Pswitch* after the last OFDM symbol of PDCC, i.e., similar to Rel-16 SSSG switching mechnism (ZTE(option 2), vivo, Intel, Nokia/NSB, Nordic) * SSSG switching may be applied after T symbols (NEC) * Option a if minimum scheduling offset restriction is not configured, otherwise *Max*{Option a, Option b}.(Qualcomm)   Option b: (InterDigital, Qualcomm)   * The application delay needed for PDCCH processing for Rel-16 minimum application delay for K0min/K2min indication is reused/extended (InterDigital) * Option a if minimum scheduling offset restriction is not configured, otherwise *Max*{Option a, Option b}.(Qualcomm) | Option 1: If the UE fails to decode the associated PDSCH and/or transmit a NACK, [Beh 2A or 2B] is applied in the slots after the NACK transmission.  Option 2: If the *RetransmissionTimerUL* is running, [Beh 2A or 2B] is applied |
| UL grant | Option c: (Apple, Huawei/HiSilicon, ZTE/Sanechips, LGE)   * after the last OFDM symbol of PUSCH transmission if *drx-RetransmissionTimerUL* is not configured (Apple) * after the last OFDM symbol of PUSCH transmission (Huawei/HiSilicon, ZTE(option1)) * (LGE)   **Option g: (Ericsson)**   * For SSSG-switching indicated via scheduling DCI format 0-1/0-2, UE applies the switching command (i.e., to the indicated SSSG) after an RRC configured delay. If the timer is not configured, the minimum application delay for SSSG switching applies. (Ericsson)   **Option h: (Apple, MediaTek)**   * after the *drx-RetransmissionTimerUL* expires if *drx-RetransmissionTimerUL* is configured (Apple, MediaTek)   **Option a: (ZTE/Sanechips, vivo, Intel， Nokia/NSB, Nordic, NEC)**   * *Pswitch* after the last OFDM symbol of PDCCH, i.e., similar to Rel-16 SSSG switching mechnism (ZTE(option 2), vivo, Intel， Nokia/NSB, Nordic) * SSSG switching may be applied after T symbols (NEC) |  |
| Timer expired | * Start Beh 2 in the slot after the SSSG timer expires (Huawei/HiSilicon) * Option a, i.e., similar mechanism to Rel-16 SSSG switching mechnism (ZTE, vivo, CATT, Intel) |  |

According to Table 1, the following package is proposed

|  |
| --- |
| **[High] Proposal 5-1 (v1)**   * **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.     - If the UE fails to decode the associated PDSCH and/or transmit a NACK, UE performs Beh 1 (i.e., the PDCCH skipping is stopped) at the first slot after the last OFDM symbol of the NACK transmission. * **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 Wth slot after the last OFDM symbol of the PDCCH transmission.       * W is configured by RRC,         + If W is not configured, the default value is 1. * **Case 3:**    + Upon detecting a scheduling DCI format 1-1/1-2 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       * If the UE fails to decode the associated PDSCH and/or transmit a NACK, UE performs [Beh 2/2A/2B] (i.e., the SSSG switching is stopped) at the first slot after the last OFDM symbol of the NACK transmission.       * FFS the application delay is same or different if minimum scheduling offset restriction is configured * **Case 4:**    + Upon detecting a scheduling DCI format 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 if Y is not configured       * FFS the application delay is same or different if minimum scheduling offset restriction is configured     - the UE applies SSSG switching on the serving cell at the Yth slot after the last OFDM symbol of the PDCCH transmission if Y is configured by RRC * **Case 5:**    + 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. * Note: *Pswitch* is defined in Table 10.4-1 in TS38.213, *Pswitch* = [X] symbols for SCS configuration u =3, FFS X = 25 or 39 * FFS values of Y and W |

### Companies views (1st round)

|  |  |
| --- | --- |
| **Company** | **Comment** |
| CATT | We can NOT agree with the proposal in general. First, PDCCH skipping does not depend on the HARQ operation and whould not wait for A/N feedback if PDSCH is scheduled. The application delay for PDCCH skipping and SSSG switching should not be different for DL DCI (DCI format 1\_1 and 1\_2) and UL DCI (DCI format 0\_1 and 0\_2). |
|  |  |
| Samsung | For Case 1, we think at least option b is needed even if PDSCH is decoded successfully. If cross-slot scheduling is enabled, UE may needs more than one slot to decode PDCCH, so we suggest to modify the first bullet to support option b.  For Case 2, we don’t see the reason to consider different applicable delay for different DCI formats. The application delay is limited by PDCCH decoding time and impact to PDSCH/PUSCH. The type of triggering DCI doesn’t matter.  For Case 3 and Case 4, the application delay is only limited by PDCCH decoding time, so we support to reuse Rel-16 minimum application delay for K0min/K2min indication directly. *Pswitc* for unlicensed band doesn’t consider PDCCH decoding impacted by cross-slot scheduling.  For Case 5, we don’t think any application delay is needed.  In addition, UE behaviour during the application delay should be clarified. UE should still be able to receive scheduling PDCCH, but doesn’t expect to receive inconsistent PDCCH monitoring adaptation. |
| Panasonic | On 5-1, we think to reuse the application delay for K0min/K2min would be starting point. Also, we are not sure to differentiate the cases for PDCCH skipping and SSSG switching, as they are both indicated by a UL or DL scheduling DCI. |
| Huawei, HiSilicon | **[High] Proposal 5-1 (v1):** Firstly we don’t think we need to consider special cancel of SSSG switching for retransmission, i.e. Case 3 and Case 4. And it is difficult and very complicated for UE implement to have behaviour of “the SSSG switching is stopped”.  For SSSG switching, there are lots of companies supporting option d and c, we think it should be better to consider based on the ACK/NACK feedback and scheduled PUSCH transmission to determine the application of SSSG swithing.  For PDCCH skipping, to cancel the PDCCH skipping at the first slot after the last OFDM symbol of the NACK would impact the power saving gain of PDCCH skipping a lot. Considering there are also a number of companies prefer larger skipping durations, it should be allowed UE to continue PDCCH skipping when the retransmission timer expires. So, we think should be based on the retransmission timer if DRX configured or a timer explicitly configured by gNB to decide whether scheduling DCI is monitored during a skipping duration. |
| ZTE, Sanechips | We think there is no need to complicate the application delay in so many different implementations, such as no need to distinguish delay for UL/DL DCI formats.  Furthermore, for case 1 and case 3, UE may frequently update PDCCH monitoring behavior within a small time duration, if it transmits NACK. For example, if timing of HARQ-ACK is larger than *Pswitch* , (it will occur in most implementation casesconsidering the limitation of K0, K1, TDD pattern, etc,), UE has to first switch to a target group indicated by DCI, then fall back to the previous behavior after NACK is transmitted. We think it is not friendly to UE power saving and data scheduling.  For timer based adapation, we agree with case 5 and we think it is straightforward to consider the legacy application delay in TS 38.213.  In the case that adaptation is triggered by scheduling DCI, HARQ-ACK or cross-slot scheduling can be considered. Therefore, we prefer the following options:   * Option 1: PDCCH monitoring adaptation command applies after PUSCH transmission if triggered by UL DCI. PDCCH monitoring adaptation command applies after HARQ-ACK transmission if triggered by DL DCI. * Option 2: Reuse the application delay for K0min/K2min indication if K0min/K2min is configured. Otherwise, the application delay is “ZERO” for PDCCH skipping, and the application delay triggered by timer can be reused for SSSG switching. |
| Nordic | Cannot agree on this proposal  Skipping application should not depend on NACK  Case 2 is SSSG switching not skipping  We prefer that application delay mechanisms for SSSG and Skipping are independent. |
| Vivo | For PDCCH skipping, we think ‘zero’ application delay is preferred since the UE is not expected to receive another PDCCH immediately. In order to minimize the retransmission impact (which has been agreed to study this impact in RAN1#104), Ue stop PDCCH skipping after NACK transmission is needed.  For SSSG switching, we think either optin a or d can be considered. |
| Nokia(1st round) | For PDCCH skipping, for sake of simplicity, the PDCCH skipping could be cancelled if the DL TB cannot be decoded and NACK needs to be sent. Correspondingly for  For SSSG switching, as the PDCCH monitoring continues, while higher or reduced rate, there does not seem to be any need for special handling of the HARQ or UL scheduling. UE can switch and (after Pswitch) monitor according to the active SS set(s).  We would suggest to discuss further and try to reduce the number of options. |
| LG | We don’t think application delay of UL and DL should be different. For example, for case 2, why is W needed only for UL DCI?  Regarding SSSG switching, we share the view with ZTE, sanechips. If case 3 and/or case 4 is adopted, doubled application delay can happen. |
| Ericsson1 | Support. |
| Intel | Do not support. In our view, HARQ outcome or PUSCH transmission should not impact PDCCH skipping |
| MTK | Case 1:  We are fine with Case 1 if the application delay of cross-slot scheduling is considered.  Case 2:  We are fine with Case 2. But it is needed to clarify that whether the skipping duration starts counting at the first slot after the last OFDM symbol of the PDCCH transmission  Case 3:  To avoid swtiching SSSG frequently, we suggest to use the similar mechanism as Case 4. UE can switch to the indicated SSSG at the Wth slot after the last OFDM symbol of the PDCCH transmission. W can be configured as k0+k1 to handling the application delay of cross-slot scheduling and HARQ-ACK issue. If NACK is transmitted, UE is expected not to switch SSSG.  . |
| Qualcomm | For Case 1, it seems that only Option 1 in Table 1 (Beh 1 when NACK) is captured. In our view, since there are some companies supporting Option 2 (ReTx timer), it would be fair to capture both options.  For Case 4, since there is only one company supporting RRC configured delay Y, it could be kept FFS. |

### Updated proposals(before Nov12 GTW session)

* ***FL Recommendations*** : considering many comments are received from different angles, moderator suggests not to dicuss it online in the GTW session. Moderator suggests to list options for further discussions.

### Updated proposals(after Nov12 GTW session)

Response to companies’ comments,

Samsung

* An application delay for SSSG#0 after Rel-16 SSSG switching timer exipry is also introduced. Similar mechanism can be used in Rel-17. Because UE cannot prepare to switch before the timer exipry (potential DCI indicating SSSG switching can be occur ),the application delay is nessasry after timer exipry.

Qualcomm, Huawei

* With interaction wth *RetransmissionTimerDL/UL*, a different solution for DRX and no DRX is expected. In the TS38.213 discussion, the editor suggests to capture the behaviour in TS38.213. Hence, to avoid any cross-layer description, purely phy solution is suggested. Otherwise, it is suggested to discuss retransmissiontimer based adaptation in RAN2 since the spec impact is MAC spec which is maintained by RAN2.

Huawei

* The option d and c is added in the proposed **Proposal 5-1 (v2)**

CATT, Panasonic, SAmsung

* Many companies has interests to consider the application has some impact by the retransmission in order to avoid negative impact. This is also agreed to be further study. If application delay does not only account for the processing of PDCCH but also other aspects, e.g., the indication applies after the ACK transmission for downlink, the application delay can be different for uplink and downlink.

ZTE, Samsung

* Option b is added in the proposed **Proposal 5-1 (v2)**

Nokia

* Agree with you we can make decision later, but I suggest we should narrow down the options first.

LG, Qualcomm

* The W and Y in my understanding is for uplink, the gNB need some time for preparing the retransmission. Copy and paste the explanation from R1-2112152

*For the case of the UE is scheduled with uplink grant, the NW only knows that the PDCCH containing the scheduling DCI is successfully decoded when the NW receives the PUSCH from the UE. It should be noted, however, the reliability of the PUSCH is lower than that of PDCCH. For example, it is possible that the UE successfully decodes the PDCCH, transmits the PUSCH, but the NW failed to receive/decode the PUSCH. Therefore, having the PUSCH as an indication to start the indicated SSSG may not be beneficial. In this circumstance, when the UE is indicated by the NW to switch from the dense PDCCH monitoring to sparse PDCCH monitoring, the UE will start the sparse PDCCH monitoring while the NW is still in the dense PDCCH monitoring.*

*Considering this, timer-based application delay can be considered. The timer can be configurable to the NW so that the UE can be configured with a delay which cover the PUSCH transmission and if it is deemed to be necessary, the PUSCH retransmission.*

* ***FL recommendations***: With that, moderator suggest to add more alternativesand discuss the proposals as follows, companies are encouraged to provide
* Which alternative is preferred for PDCCH skipping and SSSG switching respectively
* Any suggestion and modification/update to the alternatives

And the cases used in the proposal are defined as follows,

* **Case 1:** Upon detecting a scheduling DCI format 1-1/1-2 indicating PDCCH skipping (i.e., Beh 1A),
* **Case 2:**Upon detecting a scheduling DCI format 0-1/0-2 indicating PDCCH skipping (i.e., Beh 1A),
* **Case 3:** Upon detecting a scheduling DCI format 1-1/1-2 indicating SSSG switching (i.e., Beh 2/2A/2B),
* **Case 4:** Upon detecting a scheduling DCI format 0-1/0-2 indicating SSSG switching (i.e., Beh 2/2A/2B),
* **Case 5:** Upon SSSG timer exipry,

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| **[High] Proposal 5-1 (v2)**  **For PDCCH skipping**  **Alt 1 (no interaction with retransmission):**   * Case 1 and 2: Upon detecting a scheduling DCI format 1-1/1-2/0-1/0-2 indicating PDCCH skipping (i.e., Beh 1A),   + 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 for Rel-16 minimum application delay for K0min/K2min indication is reused/extended   **Alt 2 (has interaction with retransmission and applied after 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 1 slot after the last OFDM symbol of ACK transmission, otherwise the indication is not applied. * Case 2: Upon detecting a scheduling DCI format 0-1/0-2 indicating PDCCH skipping (i.e., Beh 1A),   + Alt 2a: the UE applies Beh 1A on the serving cell after the last OFDM symbol of PUSCH transmission   + Alt 2b: the application delay needed for PDCCH processing for Rel-16 minimum application delay for K0min/K2min indication is reused/extended   + Alt 2c: the UE applies Beh 1A on the serving cell at the Yth slot after the last OFDM symbol of the PDCCH transmission.     - Y is configured by RRC,       * If Y is not configured, the default value is 1. * FFS values of Y   **Alt 3 (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),   + Alt 3a and 3c: the UE applies Beh 1A on the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.   + Alt 3b: the application delay needed for PDCCH processing for Rel-16 minimum application delay for K0min/K2min indication is reused/extended   + If the UE fails to decode the associated PDSCH and/or transmit a NACK, UE performs Beh 1 (i.e., the PDCCH skipping is stopped) at the first slot after the last OFDM symbol of the NACK transmission. * Case 2: Upon detecting a scheduling DCI format 0-1/0-2 indicating PDCCH skipping (i.e., Beh 1A),   + Alt 3a: the UE applies Beh 1A on the serving cell at the first slot after the last OFDM symbol of the PDCCH transmission.   + Alt 3b: the application delay needed for PDCCH processing for Rel-16 minimum application delay for K0min/K2min indication is reused/extended   + Alt 3c: the UE applies the indication on the serving cell at the Yth slot after the last OFDM symbol of the PDCCH transmission.     - Y is configured by RRC,       * If Yis not configured, the default value is 1. * FFS values of Y   **For SSSG switching**  **Alt 1 (no interaction with retransmission):**   * Case 3 and 4: 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 * Case 5: 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 * Note: *Pswitch* is defined in Table 10.4-1 in TS38.213, *Pswitch* = [X] symbols for SCS configuration u =3, FFS X = 25 or 39   **Alt 2 (has interaction with retransmission and applied after HARQ-ACK transmission):**   * Case 3: Upon detecting a scheduling DCI format 1-1/1-2 indicating SSSG switching(i.e., Beh 2/2A/2B),   + the UE applies the indication 1 slot after the last OFDM symbol of ACK transmission, otherwise the indication is not applied. * Case 4: Upon detecting a scheduling DCI format 0-1/0-2 indicating or SSSG switching(i.e., Beh 2/2A/2B),   + Alt 2a: the UE applies the indication on the serving cell after the last OFDM symbol of PUSCH transmission   + Alt 2b: the application delay needed for PDCCH processing for Rel-16 minimum application delay for K0min/K2min indication is reused/extended   + Alt 2c: the UE applies the indication on the serving cell at the Wth slot after the last OFDM symbol of the PDCCH transmission.     - W is configured by RRC,       * If W is not configured, the default value is 1. * Case 5: 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 * Note: *Pswitch* is defined in Table 10.4-1 in TS38.213, *Pswitch* = [X] symbols for SCS configuration u =3, FFS X = 25 or 39 * FFS values of W   **Alt 3 (has interaction with retransmission and can be applied before HARQ-ACK transmission):**   * Case 3: Upon detecting a scheduling DCI format 1-1/1-2 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     - FFS the application delay is same or different if minimum scheduling offset restriction is configured     - If the UE fails to decode the associated PDSCH and/or transmit a NACK, UE performs [Beh 2/2A/2B] (i.e., the SSSG switching is stopped) at the first slot after the last OFDM symbol of the NACK transmission. * Case 4: Upon detecting a scheduling DCI format 0-1/0-2 indicating SSSG switching (i.e., Beh 2/2A/2B),   + Alt 3a: the UE applies the indication on the serving cell after the last OFDM symbol of PUSCH transmission   + Alt 3b: the application delay needed for PDCCH processing for Rel-16 minimum application delay for K0min/K2min indication is reused/extended   + Alt 3c: the UE applies the indication on the serving cell at the Wth slot after the last OFDM symbol of the PDCCH transmission.     - W is configured by RRC,       * If W is not configured, the default value is 1. * Case 5: 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 * Note: *Pswitch* is defined in Table 10.4-1 in TS38.213, *Pswitch* = [X] symbols for SCS configuration u =3, FFS X = 25 or 39 * FFS values of W |

### Companies views (2nd round)

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| **Company** | **Comment** |
| IDCC | We support Alt 2 and Alt 2a for both skipping and SSSG switching. |
| Apple | For SSSG switching, strongly support Alt 2, after HARQ ACK transmission. One comment is on “the UE applies the indication 1 slot after the last OFDM symbol of ACK transmission, otherwise the indication is not applied.” Here 1 slot is for FR1. For FR2, 2 slots are required. This is basically calculate from Pswitch time – PDCCH decoding time.   * Alt1: if UE missed the DCI, the SSSG mis-alignment between gNB and UE can happen. This can impact many PDCCH MO until reset to SSSG0. * Alt 3, we strongly object to swtich back and forward based on ACK/NACK condition. Pswitch is needed after DCI and NACK in this case. This operation complicates UE processing quite a lot without power saving benefit. For SSSG switching, we have strong preference that PDCCH adapation happens Pswitch time after ACK transmission.   For PDCCH skipping, we still prefer Alt 2, which is consistent with switching to achieve one design, and have similar power saving benefit as Alt 3 where skipping is applied “immediately” after PDCCH decoding, since skipping PDCCH monitoring while receiving/decoding PDSCH does not save UE power. We can also accept Alt 3 as compromise. For Alt 1, this can result in large retransmission delay which is not desiable. |
| ZTE, Sanechips | We support Alt 2 and Alt 2a for the two PDCCH monitoring adaptations.  For PDCCH skipping and PDCCH switching, a unified design of application delay is preferred.  Alt 2 and alt 2a can reduce the delay of retransmission and will not cause frequent switching of PDCCH monitoring behavior. |
| OPPO | We support Alt 2 for skiping. We support Alt 2 for SSSG switching and the Alt3 is Ok to us. |
| Nordic | Skipping: Alt 1, but minimum scheduling offset should be included in Skipping duration, no need for interaction between two features  SSSGswitching: Alt 1  Retransmission behaviour can be discussed separately |
| CATT | PDCCH skipping Alt 1(a)  SSSG witching Alt 1. |
| Panasonic | For PDCCH skipping, we support Alt 1b.  For SSSG switching, we are okay with Alt 1. |
| Ericsson2 | For PDCCH skipping : Support Alt 3a, Case1 (for DL):, Alt 3c, Case 2 (for UL)  For SSSG switching : Support Alt2, Case 3 (for DL), Alt 2c, Case 4 (for UL) |
| Lenovo/Motorola Mobility | For PDCCH skipping, for RAN1 perspective, Alt 1 is fine. RAN2 can discuss independently how to handle PDCCH skipping when a DRX retransmission timer is running.  For SSSG switching, we support Alt 1. |
| Samsung | For PDCCH , we support Alt2, and suggest further modification below:   * in case1, 1 slot after the last OFDM symbol of ACK transmission is not clear. We suggest to replace “1 slot” to “at the next slot” * For Alt2c in Case 2, we don’t see the reason to support RRC configured Y. It can be next slot same as for case 1.   For SSSG switching, we support Alt1, and additional modification below   * our previous comment on reusing Rel-16 minimum application delay for K0min/K2min indication directly was misunderstood. We support it for SSSG switching not for PDCCH skipping. *Pswitc* for unlicensed band doesn’t consider PDCCH decoding impacted by cross-slot scheduling. * So, for Case 3 and 4 under Alt1, we suggest to add an alternative of “the application delay needed for PDCCH processing for Rel-16 minimum application delay for K0min/K2min indication is reused/extended” |
| Intel | Support Alt1 for both PDCCH skipping and SSSG switching |
| LG | We support Alt 2 and Alt 2a for both PDCCH skipping and SSSG switching. Regarding SSSG switching we have similar view with Apple that Alt 2 has more benefits than Alt 1 and Alt 3. |
| CMCC | PDCCH skipping: support Alt 2(2a)  SSSG witching: support Alt 2(2a). |
| MTK | In Alt 2, we suggest to add a sub-bullet about NW can configure whether UE has to monitor PDCCH before ACK in case 1.   * + the UE applies Beh 1A 1 slot after the last OFDM symbol of ACK transmission, otherwise the indication is not applied     - Whether UE has to monitor PDCCH from the first slot after the last OFDM symbol of the PDCCH transmission to ACK can leave for network configuration.   For PDCCH skipping, we prefer Alt 2 (and Alt 2c for uplink), but fine with Alt 3 (and Alt 3c for uplink). For SSSG switching, we prefer Alt 2 (and Alt 2c for uplink).  To take consistency of UE behavior into consideration, we prefer Alt 2 for both PDCCH adaptation. |
| ETRI | We support Alt 2 and Alt 2a for both PDCCH skipping and SSSG switching which is a simple and robust solution. |
| Huawei, HiSilicon | For PDCCH skipping, we support Alt1. For the sake of progress, we are fine for Alt1a and Alt.1b.  For SSSG switching, we generally support Alt2. Specifically,   * For DL transmission, we support the case 3 with modification. We think no matter ACK or NACK is transmitted, the indication is appliced after the HARQ feedback, so we suggest the following modification: * Case 3: Upon detecting a scheduling DCI format 1-1/1-2 indicating SSSG switching(i.e., Beh 2/2A/2B),   + the UE applies the indication 1 slot after the last OFDM symbol of ACK/NACK transmission~~, otherwise the indication is not applied~~. * For UL transmission, we support Alt 2a of case 4. |

## Issues#6: details of indication of multiple cells case

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

### Initial proposals

**Support of multi-cell indication**

Apple

* *Proposal 9: For DCI based PDCCH monitoring adaptation, the adaptation is applied to all CCs within a RRC configured CC group.*

APT:

* *Observation 1: A single PDCCH monitoring adaptation indication for multiple cells can reduce the signalling overhead of DCI.*
* *Proposal 1: A single PDCCH monitoring adaptation indication for multiple cells should be supported.*

Ericsson

* *Proposal 8 Support intercell indication for PDCCH monitoring adaptation with DCI 1-1 for P(S)Cell, at least for the case like case 2 dormancy indication and using a new RNTI configured by higher layers.*
* *Proposal 9 For a cell for which PDCCH monitoring can be adapted, it should be possible to support different number of bits for same cell indication and intercell indication (e.g., 2-bits for indication on same cell and 1-bit for intercell indication from another cell).*
* *Proposal 10 For a cell for which PDCCH monitoring can be adapted, it should be possible to independently configure same cell indication and intercell indication.*

Huawei, HiSilicon

* *Proposal 9: Extend dormancy indication field in scheduling DCI to indicate PDCCH monitoring adaptation when multiple cell are configured.*

Qualcomm

* *Proposal 10: In the CA scenario, for the joint adaptation across CCs, carrier-group-based PDCCH monitoring adaptation is considered.*
* ***Recommendations*** : consider support joint adaptation across CCs, and Rel-16 mechnism is as start point

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| **[Medium] proposal 6-1 (v1):**  For Rel-17 DCI based PDCCH monitoring adaptation , and when UE is configured CA, down-selection of Alt 1 and Alt2   * Alt 1: The adaptation can be applied to all CCs within a RRC configured CC group.   + If one cell is adapted, all other cells in the same CC group will be adapted   + The maximum number of cells in the configured CC group is [16] * Alt 2: Extend dormancy indication field in scheduling DCI to indicate PDCCH monitoring adaptation when multiple cell are configured   + FFS details |

### Companies views (1st round)

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| **Company** | **Comment** |
| CATT | We don’t support cross-cell indication of PDCCH monitoring adaption. Since UE monitors PDCCH of each cell with CA, PDCCH monitoring adaptation should be per cell. |
| Samsung | we are generally OK with Alt1. |
| Panasonic | We think to consider CA case is reasonable for power saving operation of UE. Considering the limited time for Rel.17, we can go for a straight forward solution, e.g. per MAC entity adaptation. |
| ZTE, Sanechips | We think another option for CA case can be also considered, which is that the PDCCH monitoring adapation is only applied to the scheduled cell, which is much simpler.  It is kind of restrictive to bundle multiple cells with alt 1, or apply adaptation to other cells only when dormancy field is enable with alt 2.  We suggest to condider following alt 3 in the CA case.  Alt 3: PDCCH monitoring adapation is only applied to the scheduled cell. |
| Huawei, HiSilicon | We support Alt.2 considering PDCCH skipping in Pcell is very similar as dormancy indication in SCells. |
| CMCC | Support Alt 2, the PDCCH monitoring behaviurs on different CCs are different. |
| Nordic | in R17, we could support only self-indication (including self-scheduling and cross-carrier scheudling), but one PDCCH indicates adaption only for one cell. |
| Vivo | In rel-16, cellGroupsForSwitchingList-r16 is RRC configured to achieve group SSSG switching by one DCI. We think similar mechanism can be used in Rel-17 PDCCH monitoring adaptation. Alt 1 is preferred. |
| Nokia(1st round) | We would also think that the option of restricting the adaptation to scheduled cell could be considered at least as an alternative to Alt1. |
| Ericsson1 | Support, our preference for Alt 2 is as follows.  *Support PDCCH monitoring adaptation for multiple cells using DCI 1-1 format, at least based on case 2 dormancy-like indication and using a new RNTI configured by higher layers.* |
| Intel | Support Alt2 |
| MTK | We think this proposal should be deprioritized until the detail of single-cell scheduling DCI is finished. |
| Qualcomm | In our view, the first sub-bullet of Alt 1 seems slightly different from what is intended by the proponent companies of CC group-based adaptation. Thus, it could be revised as follows:   * Alt 1: The adaptation can be applied to all CCs within a RRC configured CC group.   + ~~If one cell is adapted, all other cells in the same CC group will be adapted~~   + Indication of PDCCH monitoring adaptation is transmitted on only one CC of the CC group   + The indicated PDCCH monitoring adaptation is applied to all cells in the same CC group   + The maximum number of cells in the configured CC group is [16] |

### Updated proposals(before Nov12 GTW session)

CATT, MediaTek think it is not need to suppor this feature or depeiotized this discussion.

For Rel-17 DCI based PDCCH monitoring adaptation , and when UE is configured CA, down-selection of Alt 1 and Alt2

* Alt 0 (3): one PDCCH indicates adaption only for single cell (including self-scheduling and cross-carrier scheudling) (Nordic, CATT, MediaTek)
* Alt 1 (3): The adaptation can be applied to all CCs within a RRC configured CC group. (Samsung, vivo Qualcomm)
  + If one cell is adapted, all other cells in the same CC group will be adapted
  + The maximum number of cells in the configured CC group is [16]
* Alt 2 (3): Extend dormancy indication field in scheduling DCI to indicate PDCCH monitoring adaptation when multiple cell are configured (Huawei/HiSilicon, CMCC, Intel)
  + FFS details
* Alt 3 (2): PDCCH monitoring adapation is only applied to the scheduled cell (ZTE/Sanechips, Nokia/NSB)
* Alt 4 (1): per MAC entity control PDCCH monitoring adaptation. (Panasonic)
* ***Recommendations*** :

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| **[Medium] proposal 6-1 (v1):**  For Rel-17 DCI based PDCCH monitoring adaptation , and when UE is configured CA, down-selection of the following alternatives~~Alt 1 and Alt2~~   * Alt 0: one PDCCH indicates adaption only for single cell (including self-scheduling and cross-carrier scheudling) * Alt 1: The adaptation can be applied to all CCs within a RRC configured CC group.   + ~~If one cell is adapted, all other cells in the same CC group will be adapted~~   + Indication of PDCCH monitoring adaptation is transmitted on only one CC of the CC group   + The indicated PDCCH monitoring adaptation is applied to all cells in the same CC group   + The maximum number of cells in the configured CC group is [16]   + Support up to [4] CC groups for a signle UE.     - Monitoring adaptation indication across different CC groups is not support. * Alt 2: Extend dormancy indication field in scheduling DCI to indicate PDCCH monitoring adaptation when multiple cell are configured   + FFS details, e.g., Support PDCCH monitoring adaptation for multiple cells using DCI 1-1 format, at least based on case 2 dormancy-like indication and using a new RNTI configured by higher layers * Alt 3: PDCCH monitoring adapation is only applied to the scheduled cell. * Alt 4: per MAC entity control PDCCH monitoring adaptation. |

### Companies views (2nd round)

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| **Company** | **Comment** |
| Qualcomm | We are okay with the proposal. In particular, we support Alt 1. |
| Apple | Support Alt 1 |
| ZTE, Sanechips | We support Alt 3, which is the simplest one. |
| OPPO | We think the Alt1 should be straightforward. We support Alt1. Others should be justified. |
| Nordic | Support Alt 0 = Alt3 |
| CATT | We are OK with Alt 2 and Alt 3. However, we would lik to clarify Alt2 what the UE behavior is when both PDCCH monitoring adaptation and SCell dormancy are configured |
| Panasonic | We can be fine with the proposal but just note that the power saving gain from the previous simulation is observed from single carrier case. To extend to CA case, if different CCs are operating differently in terms of timing on the micro-sleep and light sleep, the gain shall be drgraded by reduced sleep time. Thus we suggest to check the power saving gain acquired by each alternative. |
| Ericsson2 | Support –Alt 2. |
| Lenovo/Motorola Mobility | Support Alt 0 and Alt 1. |
| Samsung | Support Alt1 |
| Intel | Support Alt 2 |
| LG | As Panasonic commented, we might need a time to verify extending monitoring adaptation for single cell case to CA case. We think this proposal should be deprioritized until the detail of single cell case is finished and discussed later. |
| CMCC | Support Alt 0 and Alt 2. |
| MTK | Support Alt 0, and agree with the LG’s comment. |
| ETRI | We are fine with the proposal and prefer Alt 1. |
| Huawei, HiSilicon | OK with proposal and support Alt2. |

## Issues#7: non-scheduling DCI based PDCCH monitoring adaptation

### Initial proposals

Support of proposal 7-1: Spreadtrum, Qualcomm, CMCC, ETRI, Intel, Apple, Nokia, NSB, CATT

Object of proposal 7-1: MediaTek

* ***Recommendations*** : continue working on the specification impact. Companies are encouraged to provide further proposals w.r.t specification impact.

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| **[Medium] proposal 7-1 (v1):**   * PDCCH does not schedules data and indicates SSSG switching or PDCCH skipping for an active BWP in active time is supported by   + DCI Format 1\_1 (SCell dormancy case 2 like) |

For proposal 7-2:

* Outside active time:
  + Support : Lenovo/MotM, Qualcomm, LGE, ETRI
  + Object: MediaTek
* Inside active time:
  + Support : Huawei/HiSilicon, LGE, Intel, Apple
  + Object: MediaTek

And some companies [Panasonic, Spreadtrum, MTK] think we should deprioritize proposal 7-2 at this moment.

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| **[Medium] proposal 7-2 (v1):**   * DCI format 2\_6 outside active time is supported to indicate SSSG switching or PDCCH skipping for an active BWP in active time when DRX is configured. * DCI format 2\_6 being received in active time is supported to indicate SSSG switching or PDCCH skipping for an active BWP in active time when DRX is configured. |

### Companies views (1st round)

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| **Company** | **Comment** |
| CATT | We strongly against use DCI format 2\_6 for PDCCH monitoring daptation since DCI format 2\_6 is used for DRX adaptation when UE is not required to monitor PDCCH. |
| Samsung | On P7-1, we object it. The signalling overhead is too large for non-scheduling DCI.  On P7-2: We are fine with the first bullet. DCI 2\_6 should not be monitored within active time. The second bullet reverts R16 design, which is unacceptable to us. |
| Spreadtrum | **proposal 7-1 (v1): support**  **proposal 7-2 (v1): not support, since DCI format 2\_6 is outside active time, and changing it inside active time will cause large spec impact.** |
| Panasonic | On 7-1, 7-2, we should deprioritize and deal with other higher priority topics. |
| ZTE, Sanechips | The PDCCH monitor adaptation indicated by scheduling DCI or timer is flexible enough without any consideration about other non-scheduling DCIs. Therefore, proposal 7-1 and proposal 7-2 are not needed. |
| DOCOMO | proposal 7-1: Support.  Proposal 7-2: Not Support. In case of outside active time, DCI format 2\_6 is used to wake-up the UE to receive data during On-duration, and if UE is indicated to monitor on-duration, there will be scheduling data for UE. In our view, as discussed in proposal 8-3, it is enough to define the behavior when UE is indicated to monitor PDCCH within on-duration.  For inside active time, we think there are many spec impact. |
| IDCC | We support proposal 7-1. For proposal 7-2, we can discuss later. |
| Huawei, HiSilicon | We support proposal 7-1 and only support the inside Active time case, i.e. the second bullet, in proposal 7-2.  Regarding some comments on reverting R16 agreements, we don’t think it is a valid objection. It is always open for the extention of DCI formats if it is proved to have no backward compatibility issue. |
| CMCC | Proposal 7-1: Support  Proposal 7-2: Not Support, the PDCCH monitoring adapatation is per UE’s bahaviour, we don’t think group-common DCI 2\_6 can be used in this scenario. |
| Vivo | No strong view to P 7-1 and 7-2 |
| Nokia(1st round) | While we are fine to consider proposal 7-1 further, we would propose to consider support of DCI format 2\_0 as well.  We don’t support proposal 7-2 neither outside nor inside the active time. We don’t see need for it at outside active time, and insider active time we have other alternatives (like proposal 7-1 implies) with lower overall specification impact. |
| LG | We support the Proposal 7-2. |
| Ericsson1 | 7-1 : Not OK -We do not see the need for this for single cell indication. This can be supported for intercell PDCCH monitoring adapation for Scells (addressed in other proposals).  7-2 : Not OK. |
| Intel | Support P 7-1, Support P 7-2 when DCI 2\_6 is received inside active time |
| MTK | Deprioritize proposal 7-1 and 7-2 until the detail of scheduling DCI is finished. |

### Updated proposals(before Nov12 GTW session)

* ***FL Recommendations*** : The proposal 7-1 and 7-2 is still not stable. Moderator suggests not to dicuss it online in the GTW session.

### Updated proposals(after Nov12 GTW session)

Support of proposal 7-1: Spreadtrum, Qualcomm, CMCC, ETRI, Intel, Apple, Nokia, NSB, CATT, DOCOMO, IDCC, Huawei/HiSilicon

Not support of proposal 7-1: MediaTek, Samsung, ZTE/Sanechips, Ericsson, Panasonic

Panasonic think P 7-1 should depriotized

For proposal 7-2:

* Outside active time:
  + Support : Lenovo/MotM, Qualcomm, LGE, ETRI
  + Object : MediaTek, CATT, Spectrum, Panasonic, ZTE/Sanechips, DOCOMO, CMCC, Nokia, Ericsson
* Inside active time:
  + Support : Huawei/HiSilicon, LGE, Intel, Apple
  + Object : MediaTek, CATT, Spectrum, Panasonic, ZTE/Sanechips, DOCOMO, CMCC, Nokia, Ericsson

And some companies [Panasonic, MTK] think we should deprioritize proposal 7-2 at this moment.

* ***FL Recommendations*** :no consensus of Proposal 7-1. Continue discussion

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| **[Medium] proposal 7-1 (v1):**   * PDCCH does not schedules data and indicates SSSG switching or PDCCH skipping for an active BWP in active time is supported by   + DCI Format 1\_1 (SCell dormancy case 2 like) |

* ***FL Recommendations*** : Considering the proposal is not stable and more companies suggest not to support DCI form 2\_6, moderator suggest not to support DCI form 2\_6 for PDCCH monitoring adaptation.

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| **[Medium] proposal 7-2 (v2):**   * DCI format 2\_6 is not supported to indicate SSSG switching or PDCCH skipping for an active BWP in active time |

### Companies views (2nd round)

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| **Company** | **Comment** |
| Apple | Support P7-1.  It is important to support at least one non-scheduling DCI. Otherwise if there is no traffic, the PDCCH adapation can not be triggered.  Support P7-2 |
| ZTE, Sanechips | The PDCCH monitor adaptation indicated by scheduling DCI or timer is flexible enough without any consideration about other non-scheduling DCIs.  Therefore, proposal 7-1 is not needed.  As to proposal 7-2, there is no need for DCI format 2-6 indcating of PDCCH adaptation outside active time, either. |
| OPPO | We think it is not in the scope of UE power saving. We don’t support proposal 7-1 (v1). There is not justification in the earlier stage of the WI either.  We are ok with proposal 7-2 (v2) |
| CATT | We support both Proposal 7-1(v1) and 7-2(v2) |
| Ericsson2 | 7-1 (v1) : Suggest to revise as follows to separate out the multi-cell scheduling case  **[Medium] proposal 7-1 (v1):**   * For the 2 bit indication in self-scheduling DCIs (i.e., DCI format 1-1/0-1/1-2/0-2) for triggering the PDCCH monitoring adaptation in a single cell, PDCCH does not schedules data and indicates SSSG switching or PDCCH skipping for an active BWP in active time is NOT supported by   + DCI Format 1\_1 (SCell dormancy case 2 like)   7-2(v2) : OK. |
| Lenovo/Motorola Mobility | Proposal 7-1: support  Proposal 7-2: In Rel-17, we think DCI format 2\_6 outside active time should be able to jointly indicate a wake-up and an SSSG to monitor for a next DRX cycle, when DRX is configured. |
| Samsung | On P 7-1: we don’t support it. The signaling overhead is too large. C-DRX w/ WUS is a more appropriate PS scheme to consider for PDCCH monitoring adaptation if no traffic.  On P7-2: OK. |
| Intel | Support p7-1  Regarding P7-2, we are OK to support if this is for DCI format 2\_6 received outside active time. We think if received during active time, there is good value to consider it. Inside active time can be FFS. |
| LG | We don’t support Proposal 7-2. DCI format 2\_6 inside and/or outside DRX Active Time can be good means of monitoring adaptation indication by non-scheduling DCI. |
| CMCC | Support both. |
| DOCOMO | We support Proposal 7-1(v1) and 7-2(v2). |
| MTK | We do not support Proposal 7-1. It should be deprioritized until the detail of scheduling DCI is finished. |
| ETRI | Support Proposal 7-1.  OK with Proposal 7-2. |
| Huawei, HiSilicon | **proposal 7-1 (v1)**: when there is no traffic for a UE, non-scheduling DCI based indication can give gNB the flexibility to indicate, e.g. PDCCH skipping. So we support this proposal.  **proposal 7-2 (v2)**: similar argument as proposal 7-1, non-scheduling DCI based indication should be supported. |

## Issues#8: Others

### Initial proposals

**SR/RACH**

Support of proposal 8-1/8-2 Huawei/HiSilicon, Qualcomm, LGE, Nokia/NSB(SR only), CMCC ZTE/Sanechips, APT

* ***Recommendations***: FL recommend companies continue discussion on the aspects from this and previous discussions:
  + BSR status needs to be considered
  + Power saving gain being shown on these proposal.
  + the system does work without these function and we see them as optimization.
  + implicit switching by SR/RACH should be limited during PDCCH skipping/empty SSSG

|  |
| --- |
| **[Medium] Proposal 8-1 (v1):**  PDCCH monitoring adaptation triggered by SR is supported.  **[Medium] Proposal 8-2 (v1):**  PDCCH monitoring adaptation by RACH is supported. |

**Default SSSG for DRX On**

Support: Ericsson, DoCoMo, ETRI, Nokia, NSB

|  |
| --- |
| **[Medium] Proposal 8-3 (v1)**  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. |

**BWP switching**

Huawei pointed out the followings,

*Observation 4: 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.*

|  |
| --- |
| **[Medium] Proposal 8-4 (v1)**  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. |

**UE assistant information**

Samsung

*Propose 10: Support UE assistance information for PDCCH monitoring adaptation, including*

* *preferred search space set group,*
* *preferred PDCCH skipping duration.*

|  |
| --- |
| **[Medium] Proposal 8-5 (v1)**  Support UE assistance information for PDCCH monitoring adaptation, including   * preferred search space set group, * preferred PDCCH skipping duration. |

### Companies views (1st round)

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | On P8-1, P8-2: We are not OK with them. They are non-essential, but requires large spec efforts to complete.  On P8-3, no need. DCI based triggering as in P7-2 works better.  On P8-4, generally OK. The adaptation should be applied to target BWP after switching, similar as R16 PS scheme. But we think it’s related to application delay.  On P8-5: OK. |
| ZTE, Sanechips | OK with proposal 8-1 and 8-2.  The benefit of introducing 8-3 is uncertain, so it is not necessary to introduce this design at present. If the UE needs to switch to SSSG, it can be indicated by timer or DCI.  For proposal 8-4, support.  Proposal 8-5: not needed. |
| DOCOMO | We support the proposal 8-3. |
| Huawei, HiSilicon | OK for proposal 8-1 and 8-2.  We don’t see a need to have proposal 8-3. The UE can always do the PDCCH monitoring adaptaion by scheduling DCI or non-scheduling DCI as mentioned by proposal 7-1 and 7-2.  We support proposal 8-4. We think this part we need to finish them, as similar as that in Rel-16. Otherwise, the feature is not complete.  We are open to discuss proposal 8-5, but may be deprioritized. |
| Nokia(1st round) | On Proposal 8-1 and 8-2, we think that UE behaviour due to SR or RACH triggering (BFD etc) needs to be covered. It would seem non-intuitive to continue e.g. PDCCH skipping if SR is triggered.  Proposal 8-3 no strong view.  Proposal 8-4 I think this could be used as a starting point.  Proposal 8-5 does not seem necessary. |
| Ericsson1 | 8-1 : Support - should be configurable.  8-2: Support – should be configurable.  8-3: Support. |
| Intel | Do not support P 8-1/2/3. Support P 8-4, P 8-5 can be deprioritized or RAN2 can handle it |
| Apple | Do not support P8-1/2/3. |
| CATT | These are non-esstentail proposals and should no tbe discussed in Rel-17. |
| Lenovo/Motorola Mobility | Proposal 8-1: Support  Proposal 8-3: Not support. SSSG#0 should be a default.  Proposal 8-4: For simplicity, BWP switching delay should be included in PDCCH skipping duration.  Proposal 8-5: Not support. Transmitting UE assistance information diminishes power saving gain from PDCCH monitoring adaptation. |

# Proposals for GTW session

**[High] Proposal 1-1 (v2)**

* For Case 4 (i.e., 2 SSSG switching with PDCCH skipping) , the following is supported
  + ~~Alt a: (Alt 1 + Alt 3a)~~ 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)
  + ~~Alt b: (Alt 2 + Alt 3):~~
    - ~~If~~ *~~M~~* ~~= 1, then~~ 
      * ~~‘00’ is Beh 2~~
      * ~~‘01’ is Beh 2A~~
      * ~~‘10’ is Beh 2 and Beh 1A~~
      * ~~‘11’ is Beh 2A and Beh 1A~~
    - ~~If~~ *~~M~~* ~~= 2, then~~ 
      * ~~‘00’ is Beh 2~~
      * ~~‘01’ is Beh 2A~~
      * ~~‘10’ is Beh 2A and Beh 1A for duration T1~~
      * ~~‘11’ is Beh2A and Beh 1A for duration T2~~
  + ~~Down-selection between Alt 1 and Alt 2~~
* Note: for ‘00’ and ‘01’, UE performs Beh 1(i.e., does not perform PDCCH skipping )
* Working assumption: By a single DCI indication, a UE is not expected to simultaneously perform two behaviors of SSSG switching and PDCCH skipping.
* ~~Note: The UE can be configured to be indicated by DCI a value of X (i.e., skipping duration) among~~ *~~M~~* ~~RRC configured values by scheduling DCIs indicating PDCCH schedules data~~
* FFS SSSG switching timer behavior
* FFS: T1/T2 can be configured differently for each SSSG

**[Medium] Proposal 1-4 (v1)**

Support M = 3 for PDCCH-skipping with 2 bits indication for PDCCH monitoring adaptation case 1.

**[Medium] Proposal 1-5 (v2)**

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

* 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

**[High] Proposal 3-1 (v1)**

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...20,30, 40, 50, 60, 80, 100} for 15 kHz SCS,
* {1...40, 60, 80, 100, 100,160,200} for 30 kHz SCS,
* {1...80, 120, 160, 200, 240, 320,400} for 60kHz SCS,
* {1...160, 240, 320,400, 480, 640,800} for 120kHz SCS

**[High] Proposal 4-1 (v1)**

* 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.
      * FFS detail values
  + FFS: Equal to or longer than the applicable minimum scheduling offset

**[High] Proposal 4-2 (v2)**

* At lest when the SSSG switching is not configured, the *PDCCHSkippingDurationList-r17* is configured per BWP
  + FFS when the SSSG switching is configured

# 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:/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

# Proposals from companies’ submitted contributions

## Huawei, HiSilicon

1. **R1-2110840 Extensions to Rel-16 DCI-based power saving adaptation for an active BWP Huawei, HiSilicon**

***Observation 1: When SSSG(s) are configured, configuring skipping duration per SSSG can adapt to different traffic statistic and give gNB more flexibility.***

***Observation 2: When SSSG(s) are configured, configuring skipping duration per BWP instead of configuring it per SSSG cannot help to solve the SSSG misalignment issue.***

***Observation 3：PDCCH monitoring adaptation indicated by group common DCI format is beneficial，e.g., DCI format 2\_6 inside DRX active time, if there is no data transmission.***

***Observation 4: 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.***

Based on the observations, we have the following proposals.

***Proposal 1: The bit mapping of DCI indication PDCCH monitoring adaptation for Case 4 (i.e., 2 SSSG switching with PDCCH skipping) are as following:***

* ***M = 1, i.e. one skipping duration is configured:***
  + ***‘00’ is Beh 2***
  + ***‘01’ is Beh 2A***
  + ***‘10’ is Beh 1A, UE stays in current SSSG***
  + ***‘11’ is reserved***
* ***M = 2, i.e. two skipping durations are configurd:***
  + ***‘00’ is Beh 2 and Beh 1***
  + ***‘01’ is Beh 2A and Beh 1***
  + ***‘10’ is Beh 1A for duration T1, UE stays in current SSSG***
  + ***‘11’ is Beh 1A for duration T2, UE stays in current SSSG***

***Proposal 2: Case 5 (i.e., 3 SSSG switching and skipping) is not supported.***

***Proposal 3:*** ***The value of skipping duration(s) is configured per BWP at least when SSSG is not configured.***

***Proposal 4:*** ***When SSSGs are configured, gNB can configure skipping duration per BWP, and can additionally configure skipping duration per SSSG***

* ***If gNB provides per SSSG configured skipping duration(s) for a SSSG, UE will use the one per SSSG configured for the SSSG.***

***Proposal 5: For value X in Beh 1A, candidate skipping values are up to 20ms length. The unit of PDCCH skipping duration can be slot.***

***Proposal 6: The timer value for switching from SSSG#2 to SSSG#0 and from SSSG#1 to SSSG#0 is common and it is configured per cell or per BWP.***

***Proposal 7: Remove the bracket of agreement in RAN1#106bis-e as following:***

* ***The value of the SSSG switching timer in slots for SSSG(s) can be configured as***
* ***{1...20,40,60,80,100} for 15 kHz SCS,***
* ***{1...40, 80,100,160,200} for 30 kHz SCS,***
* ***{1...80, 160,200,320,400} for 60kHz SCS,***
* ***{1...160,320,400,640,800} for 120kHz SCS***

***Proposal 8: Use 2-bits new indication field in scheduling DCI formats, as that in draft CR of TS38.212, to indicate PDCCH monitoring occasion when only single cell is configured.***

***Proposal 9: Extend dormancy indication field in scheduling DCI to indicate PDCCH monitoring adaptation when multiple cell are configured.***

***Proposal 10: Extend MCS/NDI/RV/HARQ process number/antenna port/DMRS sequence initialization field used for SCell dormancy case 2 to indicate PDCCH monitoring adaptation.***

***Proposal 11: Support group common DCI, e.g. DCI format 2\_6 inside DRX active time, to indicate PDCCH skipping and SSSG switching.***

***Proposal 12: Support different application delay for SSSG switching and PDCCH skipping：***

* ***If DCI indicates the UE switching to another SSSG, UE applies the DCI after HARQ-ACK feedback for DL DCI format or PUSCH transmitting for UL DCI format;***
* ***If DCI indicates the UE to skip PDCCH monitoring, the application delay is max (applicable K0min, Z), after which the UE stops monitoring PDCCH in a duration.***
* ***For timer based SSSG switching, the UE starts monitoring PDCCH according to SS sets with SSSG index 0 in the slot after the timer expiration.***

***Proposal 13: 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 Type0/0A/1 or 2 PDCCH CSS is not affected by SSSG switching indication, but is affected by PDCCH skipping indication.***

***Proposal 14: 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 15: 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.***

***Proposal 16: Support SSSG switching or terminate PDCCH skipping triggered by SR and RACH.***

***Proposal 17: 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 18: To simplify UE’s implementation,*** ***UE ignores the PDCCH adaptation field in the DCI received during a skipped duration.***

***Proposal 19: UE monitors PDCCH for retransmission scheduling if the HARQ retransmission timer of any HARQ process is running during an indicated skipping duration.***

## ZTE, Sanechips

1. **R1-2110940 Extension to Rel-16 DCI-based power saving adaptation during DRX Active Time ZTE, Sanechips**

[**Observation 1: For PDCCH adaptation, the processing time for responding DL SPS PDSCH release needs to be considered.**](#_Toc87033076)

[**Observation 2: According to the agreements in RAN1#106bis-e, Option b and Option c+d are the two alternative application delay considered in both SSSG switching and PDCCH skipping.**](#_Toc87033077)

[**Proposal 1: A flag field used to enable one of SSSG switching and PDCCH skipping can be introduced.**](#_Toc87033078)

[**Proposal 2: The case 5, i.e., 3 SSSG switching and skipping, indicated by 2 bits in scheduling DCI, is not supported.**](#_Toc87033079)

[**Proposal 3: The timer value for switching from SSSG#2 to SSSG#0 and from SSSG#1 to SSSG#0 should be common and configured per BWP.**](#_Toc87033080)

[**Proposal 4: UE switches to SSSG #0 after the end of PDCCH skipping duration if both PDCCH skipping and SSSG switching are configured.**](#_Toc87033081)

[**Proposal 5: The UE should monitor PDCCH according to all of search space sets configured in the DL active BWP or SSSG#0 when the following events occur during a skipping duration.**](#_Toc87033082)

[**• SR indicated by the UE,**](#_Toc87033083)

[**• beam failure detection, or**](#_Toc87033084)

[**• random access procedure in RRC connected mode due to out-of sync, etc.**](#_Toc87033085)

[**Proposal 6: The application delay for different triggering methods should be considered separately.**](#_Toc87033086)

[**Proposal 7: The application delay for SSSG switching triggered by a timer is:**](#_Toc87033087)

[**reuse the application delay of SSSG switching in Rel-16 for μ=0/1/2;**](#_Toc87033088)

[**the value of application delay of SSSG switching for μ=3 can be 25 symbols.**](#_Toc87033089)

[**Proposal 8: For application delay for PDCCH monitoring adaptation indicated by scheduling DCI, down-select from the following two options:**](#_Toc87033090)

[**• Option 1: PDCCH monitoring adaptation command applies after PUSCH transmission if triggered by UL DCI. PDCCH monitoring adaptation command applies after HARQ-ACK transmission if triggered by DL DCI.**](#_Toc87033091)

[**• Option 2: Reuse the application delay for K0min/K2min indication if K0min/K2min is configured. Otherwise, the application delay is “ZERO” for PDCCH skipping, and the application delay triggered by timer can be reused for SSSG switching.**](#_Toc87033092)

## vivo

1. R1-2111026 Remaining issues on DCI-based power saving adaptation in connected mode vivo

**Proposal 1:** Indication of Beh 1A when three SSSG(s) (if supported) are configured is not supported.

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

**Proposal 3**

* 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...20,30, 40, 50, 60, 80, 100} for 15 kHz SCS,
* {1...40, 60, 80, 100, 100,160,200} for 30 kHz SCS,
* {1...80, 120, 160, 200, 240, 320,400} for 60kHz SCS,
* {1...160, 240, 320,400, 480, 640,800} for 120kHz SCS
* 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.

**Proposal 4**

* For value X in Beh 1A, candidate skipping values are
  + X is in the unit of slot
    - Candidate skipping values:
      * For 15 kHz SCS, {1...20}
      * For 30 kHz SCS, {1…40}
      * For 60kHz SCS, {1…80}
      * For 120kHz SCS, {1…160}
      * skipping current DRX

Proposal 5: for PDCCH monitoring adaptation case 1-4, the following application delay is supported for UE,

|  |  |  |  |
| --- | --- | --- | --- |
| Application delay  Category | | Definition#1:  Explicit indication | Definition#2:  Conditionally implicitly adaptation |
| PDCCH skipping  (case 1) | DL grant | Zero application delay or by implementation  (i.e. option f or option i) | If the UE fails to decode the associated PDSCH and/or transmits a NACK, Beh 1 is applied in the slots after the NACK transmission.  (i.e., option j) |
| UL grant | Zero application delay or by implementation or by RRC configured application delay  (i.e. option f or option i or option j) | N/A |
| SSSG switching  (case 2,3,4) | DL grant | The application timelines provided in Table 10.4-1 in TS38.213 for search space group switching for unlicensed band form is reused. And for SCS configuration , FFS X = 25 or 39  (i.e. option a)\* | If the UE fails to decode the associated PDSCH and/or transmits a NACK, Beh 2A or 2B is applied in the slots after the NACK transmission. |
| UL grant | 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  (i.e. option a)\* | N/A |

## Spreadtrum Communications

1. R1-2111105 Discussion on power saving techniques for connected-mode UEs Spreadtrum Communications

Rel-17 SSSG switching technique

***Proposal 1: The wakeup indication for Rel-17 SSSG switching technique should be down prioritized.***

***Proposal 2: The state machine for Rel-17 SSSG switching technique should be down prioritized, or simplified as much as possible.***

***Proposal 3: The application delay for Rel-17 SSSG switching technique can be defined.***

Rel-17 PDCCH skipping technique

***Proposal 4: The wakeup indication for Rel-17 PDCCH skipping technique is not supported.***

***Proposal 5: The state machine for Rel-17 PDCCH skipping technique is not supported.***

***Proposal 6: The application delay for Rel-17 PDCCH skipping technique is zero.***

Scheduling DCI

***Proposal 7: The bits size for indication in self-scheduling DCI is configurable.***

***Proposal 8: PDCCH skipping and Rel-17 SSSG switching should be separately triggered by DCI.***

***Proposal 9: The indication of PDCCH skipping and Rel-17 SSSG switching in cross-cell scheduling DCI means that PDCCH skipping or Rel-17 SSSG switching occurs in the source cell.***

***Proposal 10: The number of values of skipping duration for 2-bit indication is 3.***

DCI fields

***Proposal 11: Consider also the following DCI fields for PDCCH that schedules data and also indicates PDCCH monitoring adaptation by SSSG switching and PDCCH skipping.***

* ***Reusing the Rel-16 indication of cross-slot scheduling***
* ***Reusing the Rel-16 Indication of SCell dormancy***

Non-scheduling DCI with C-RNTI scrambling

***Proposal 12: Support the non-scheduling DCI with C-RNTI scrambling that indicates PDCCH monitoring adaptation by SSSG switching and PDCCH skipping.***

## NEC

1. R1-2111181 Discussion on DCI-based power saving adaptation NEC

**Proposal 1: 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.**

**Proposal 2: DCI format DCI 1-1, 0-1, 1-2 and 0-2 should support the same PDCCH monitoring adaptation configurations.**

**Proposal 3: PDCCH monitoring skipping may be applied without delay and SSSG switching may be applied after *T* symbols.**

## CATT

1. R1-2111269 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 interval indication changes.***

***Proposal 2: For the Beh.2 and Beh.2A, it would clarify that the PDCCH skipping is not performed when UE is indicated to monitor PDCCH according to the configured SS sets with the group index 0 or 1, i.e. SSSG#0 or SSSG#1.***

***Proposal 3: The PDCCH skipping is a specific behavior associated with a given Search Space set.***

***Proposal 4: The 2 bits adaptation indication could be used for indicating the two SSSGs and the PDCCH skipping for the different skipping durations as shown in Table 3.***

***Table 3. The 2-bit indication for UE adaptation behaviors when SSSG is configured***

|  |  |
| --- | --- |
| ***Adaptation indication in DCI*** | ***UE behaviors*** |
| ***00*** | ***Beh 2 without PDCCH skipping*** |
| ***01*** | ***Beh 2A without PDCCH skipping*** |
| ***10*** | ***Beh 1A duration 1*** |
| ***11*** | ***Beh 1A duration 2*** |

***Proposal 5: For the Beh.2, Beh.2A and Beh.2B, it would clarify that the PDCCH skipping is not performed when UE is indicated to monitor PDCCH according to the configured SS sets with the group index 0, 1 or 2, i.e. SSSG#0, SSSG#1 or SSSG#2.***

***Proposal 6: The 2 bits adaptation indication could be used for indicating the three SSSGs and the PDCCH skipping as Table 4 and the timer behavior is not necessary when Beh.1A-PDCCH skipping is indicated.***

***Table 4. The 2-bit indication for UE adaptation behaviors when three SSSG is configured***

|  |  |
| --- | --- |
| ***Adaptation indication in DCI*** | ***UE behaviors*** |
| ***00*** | ***Beh 2 without PDCCH skipping*** |
| ***01*** | ***Beh 2A without PDCCH skipping*** |
| ***10*** | ***Beh 2B without PDCCH skipping*** |
| ***11*** | ***Beh 1A of duration 1 in the given SSSG*** |

***Proposal 7: For the Beh 1A-PDCCH skipping, the skipping duration X is configured per Search Space.***

***Proposal 8: The skipping duration X would be defined as skipping the 2K times of the monitoring periodicity, such as 1, 2, 4 etc. times of the monitoring periodicity, which means that UE skips the subsequent 2K -1 monitoring periodicities.***

***Proposal 9: The skipping duration configuration could be different for DCI format x\_1 and DCI format x\_2 based on its configuration per Search Space.***

***Proposal 10: The parameter configuration of the skipping duration in the RRC signalling in TS38.311 is also provided as following:***

***SearchSpace* information element**

-- ASN1START

-- TAG-SEARCHSPACE-START

SearchSpace ::= SEQUENCE {

searchSpaceId SearchSpaceId,

controlResourceSetId ControlResourceSetId OPTIONAL, -- Cond SetupOnly

monitoringSlotPeriodicityAndOffset CHOICE {

sl1 NULL,

sl2 INTEGER (0..1),

sl4 INTEGER (0..3),

sl5 INTEGER (0..4),

sl8 INTEGER (0..7),

sl10 INTEGER (0..9),

sl16 INTEGER (0..15),

sl20 INTEGER (0..19),

sl40 INTEGER (0..39),

sl80 INTEGER (0..79),

sl160 INTEGER (0..159),

sl320 INTEGER (0..319),

sl640 INTEGER (0..639),

sl1280 INTEGER (0..1279),

sl2560 INTEGER (0..2559)

} OPTIONAL, -- Cond Setup

duration INTEGER (2..2559) OPTIONAL, -- Need R

monitoringSymbolsWithinSlot BIT STRING (SIZE (14)) OPTIONAL, -- Cond Setup

... ...

SearchSpaceExt-r17 ::= SEQUENCE {

StopPDCCHMonitoringDurationList-r17-perSearchSpace SEQUENCE (SIZE (1..maxNrofPDCCHMonitoringDurations)) OF StopPDCCHMonitoringDuration-r17

}

StopPDCCHMonitoringDuration-r17 ::= SEQUENCE {

StopPDCCHMonitoringDuration-r17-perSearchSpace INTEGER (0..X),

}

}

-- TAG-SEARCHSPACE-STOP

-- ASN1STOP

***Proposal 11: The application delay for PDCCH skipping should be Option f, which application delay is “ZERO” for PDCCH skipping. PDCCH skipping would be applied at the first symbol after the last symbol of the received PDCCH with the adaptation indication.***

***Proposal 12: The application delay for SSSG switching indicated by DCI and timer expiration would be the different.***

***Proposal 13: The application delay for timer based SSSG switching would be the legacy delay or the Option d: PDCCH monitoring adaptation command applies after HARQ-ACK transmission (or plus some margin for HARQ-ACK decoding). The PDCCH adaptation would be performed at the beginning of the first slot that is at least symbols after a slot where the timer expires or after the slot of HACK-ACK of the last retransmission is sent from the UE.***

***Proposal 14: The application delay for DCI based SSSG switching would be Option d: PDCCH monitoring adaptation command applies after HARQ-ACK transmission (or plus some margin for HARQ-ACK decoding). The PDCCH adaptation would be performed after the slot of HACK-ACK of the last retransmission is sent from the UE.***

***Proposal 15: The non-scheduling DCI should also be supported for PDCCH monitoring adaptation to dynamically indicate UE to reduce the PDCCH monitoring without any changes of Search Space configuration.***

## OPPO

1. R1-2111327 DCI-based power saving adaptation solutions OPPO

***Proposal 1: Indication field for triggering PDCCH monitoring adaptation is unified.***

***The number of indication bits could be 1 or 2, depending on the number of adaptation behaviors configured.***

***Proposal 2: In case of indicating PDCCH search space sets groups by the DCI bits, a default SSSG is always configured.***

***If 3 SSSGs is configured simultaneously, restricted state transition should be applied in the adaptation.***

***Proposal 3: When multiple PDCCH search space groups are switchable, autonomous PDCCH monitoring adaptation to the default SSSG is triggered by timer.***

***Only one timer will be activated for the autonomous fallback adaptation of SSSG.***

***Proposal 4: 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.***

***Proposal5:***

***For indication of 3 skipping durations, ‘11’ is Beh 1A with skipping duration 3.***

***For 2 SSSG switching, support 2 skipping duration indications.***

***Supporting Case 5, i.e., 3 SSSG switching and 1 skipping.***

***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.***

***Proposal 9: No further DCI format other than 1\_1, 0\_1, 1\_2 and 0\_2 is used for triggering PDCCH monitoring adaptation.***

## Intel Corporation

1. R1-2111506 Discussion on DCI-based power saving adaptation in active time Intel Corporation

**Observation 1: Use of DCI format 2\_6 for PDCCH monitoring adaptation during active time doesn’t create any ambiguity regarding the expected UE behavior, since monitoring occasions are mutually exclusive when format 2\_6 is used as wake up signal before DRX ON.**

**Observation 2:**

* **PDCCH monitoring adaptation can be potentially triggered by both scheduling and non-scheduling DCI formats and it is expected that unified approach is taken regarding start of the adaptation**
* **Impact to HARQ retransmission due to PDCCH monitoring adaptation can be avoided by gNB implementation**

**Proposal 1: For Case 4 (i.e., 2 SSSG switching with PDCCH skipping), support indication of following combination of behaviors for M =2 skipping durations.**

|  |  |
| --- | --- |
| **Codepoint** | **Behv** |
| 00 | Behv 2 |
| 01 | Behv 2A |
| 10 | Behv 1A with first duration |
| 11 | Behv1A with second duration |

**Proposal 2: Multiple PDCCH skipping durations can be configured by RRC signaling per BWP.**

* **Possible values for skipping duration include 4ms, 8ms, 16ms, 32ms, 64ms etc.**

**Proposal 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.**

**Proposal 4: Support indication of PDCCH monitoring adaptation by following ways.**

* **DCI Format 1\_1 (SCell dormancy case 2) when not scheduling data.**
* **DCI Format 2\_6 during active time.**

**Proposal 5: PDCCH monitoring adaptation should not be dependent on HARQ outcome or start of PUSCH transmission.**

**Proposal 6: Adopt Option a and Option b for SSSG switching and PDCCH skipping, respectively, for application delay.**

## CMCC

1. R1-2111619 Discussion on PDCCH monitoring reduction during DRX active time CMCC

**Proposal 1. Support Case 5 (i.e., 3 SSSG switching and skipping) for PDCCH monitoring adaptation.**

**Proposal 2. For Case 4 (i.e., 2 SSSG switching with PDCCH skipping), the bit mapping is:**

* **‘00’ is Beh 2 + Beh 1**
* **‘01’ is Beh 2 + Beh 1A**
* **‘10’ is Beh 2A + Beh 1**
* **‘11’ is Beh 2A + Beh 1A**

**Proposal 3. Support 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.**

**Proposal 4. A default SSSG can be configured and applied for the following cases:**

* **SSSG switching triggered by SR**
* **SSSG switching triggered by RACH**

**Proposal 5. The skipping duration(s) is configured per BWP.**

**Proposal 6. Format 1\_1 (SCell dormancy case 2) is supported as non-scheduling DCI indication for PDCCH monitoring adaptation in active time for an active BWP.**

## Panasonic

1. R1-2111677 Potential extension(s) to Rel-16 DCI-based power saving adaptation during DRX ActiveTime Panasonic

**Proposal 1: On bit mapping design of DCI indicated PDCCH monitoring adaptation, Case 5 and Case 3 should be supported as a single case, where the state ‘11’ UE behaviour is RRC configurable.**

**Proposal 2: 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,**
  + **‘00’ is Beh 2**
  + **‘01’ is Beh 2A**
  + **‘10’ is Beh 1A with skipping duration 1**
  + **‘11’ is Beh 1A with skipping duration 2**

**Proposal 3: PDCCH scrambled by C-RNTI is monitored in Type 0/1/1A/2 CSS.**

**Proposal 4: 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 5: No need to restrict skipping duration to be shorter than SSSG initial timer value.

Proposal 6: When SSSG timer expires within PDCCH skipping duration, UE perform SSSG fallback switching. PDCCH skipping continues until the expire of PDCCH skipping duration.

Proposal 7: 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, which are configured per BWP.

## Samsung

1. R1-2111750 Discussion on DCI-based power saving techniques Samsung

**Proposal 1: For Case 4 (i.e., 2 SSSG switching with PDCCH skipping), support the following code-point mapping**

* **When only one PDCCH skipping duration is configured, i.e. M = 1** 
  + **‘00’ is Beh 2 and Beh 1**
  + **‘01’ is Beh 2A and Beh 1**
  + **‘10’ is Beh 1A for duration T1, for current SSSG**
  + **‘11’ reserved.**
* **When two PDCCH skipping duration is configured, i.e. M = 2**
  + **‘00’ is Beh 2 and Beh 1**
  + **‘01’ is Beh 2A and Beh 1**
  + **‘10’ is Beh 1A for duration T1, for current SSSG**
  + **‘11’ is Beh 1A for duration T2, for current SSSG**

**Proposal 2: For Case 5 (i.e., 3 SSSG switching and skipping), support the following code-point mapping:**

* **‘00’ is Beh 2**
* **‘01’ is Beh 2A**
* **‘10’ is Beh 2B**
* **‘11’ is Beh 1A for current SSSG**

**Proposal 3: Support up to 3 PDCCH skipping duration(s) configured per DL BWP.**

**Proposal 4: If the UE monitors PDCCH according to SSSG#2 and the timer expires, support Alt 1: the UE monitoring PDCCH according to Beh 2.**

**Proposal 5: Support Alt 3, i.e. the timer value for switching from SSSG#2 to SSSG#0 and from SSSG#1 to SSSG#0 is common and configured per BWP.**

**Proposal 6: Support the following timer behaviour for UE to fall-back to default SSSG, i.e. SSSG#0:**

* **UE resets the timer after the application delay from a slot when the UE receives an indication of SSSG#1 or SSSG#2 in the slot**
* **When the timer is running, the UE decrements the timer after a slot when the UE does not receives an indication of SSSG#1 or SSSG#2 in the slot**

**Proposal 7: For PDCCH monitoring adaptation indication of Beh 1A, support Option d for downlink grant and Option c for uplink grant as application delay.**

**Proposal 8: For PDCCH monitoring adaptation indication of a SSSG, i.e. Beh 2/2A/2B, support Option b, i.e. reuse Rel-16 minimum application delay for K0min/K2min indication.**

**Proposal 9: 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.**

**Propose 10: Support UE assistance information for PDCCH monitoring adaptation, including**

* **preferred search space set group,**
* **preferred PDCCH skipping duration.**

## Apple

1. R1-2111886 Enhanced DCI-based power saving adaptation Apple

***Proposal 1: For case 1 where only PDCCH skipping is signaled with M=2 or 3, enable RRC configured skipping step to “until next DRX cycle”.***

***Proposal 2: When 3 SSSGs are configured, SSSG2 is associated with empty SS set.***

***Proposal 3: In case 3 when Beh 2/2A/2B are signaled in one DCI, and Beh 2B is used to emulate PDCCH skipping,***

* ***Beh 2B can be triggered from either default SSSG, or non-default SSSG.***
* ***Different timer can be configured per non-default SSSG when 3 SSSGs are enabled.***
* ***When empty SSSG2 is triggered from non-default SSSG 1, freeze timer 1 of SSSG1 and start counting down of timer 2. When timer 2 expires, fall back to SSSG 1.***

***Proposal 4: In case 4 when both Beh 1/1A/2/2A is enabled, use one bit in DCI to signal 2/2A, one bit in DCI t signal 1/1A.***

* ***Different skipping duration can be configured per SSSG.***
* ***When PDCCH skipping is triggered from non-default SSSG, the non-default SSSG timer (if configured) freeze during skipping duration.***
* ***When both SSSG switching bit and PDCCH skipping bit are triggered with one DCI, PDCCH skipping is applied first, after skipping, the UE continue monitoring with the triggered SSSG.***

***Proposal 5: Do not support case 5, 3 SSSG switching and skipping***

***Proposal 6: When PDCCH monitoring adaptation is triggered by DCI format 1-1 and 1-2, application delay applies after the last OFDM symbol of ACK transmission. Application delay can be 1 slot considering gNB ACK decoding time and UE processing time to apply the new configuration.***

***Proposal 7: When PDCCH monitoring adaptation is triggered by DCI format 0-1 and 0-2, application delay applies after the last OFDM symbol of PUSCH transmission when drx-RetransmissionTimerUL is not configured or longer than a threshold.***

***Proposal 8: When PDCCH monitoring adaptation is triggered by DCI format 0-1 and 0-2, application delay applies after drx-RetransmissionTimerUL expires if drx-RetransmissionTimerUL is configured and less than a threshold.***

***Proposal 9: For DCI based PDCCH monitoring adaptation, the adaptation is applied to all CCs within a RRC configured CC group.***

***Proposal 10: For PDCCH based adaptation using non-scheduling DCI, enable DCI format 1-1 with triggering bits per cell group.***

***Proposal 11: For PDCCH based adaptation using non-scheduling DCI, enable DCI format 2-6 monitoring in DRX-ON duration, with triggering bits per cell group indication.***

***Proposal 12: Allow more than 2 bits in non-scheduling DCI, with maximum skipping size can be configured to until next DRX cycle.***

***Proposal 13: When PDCCH monitoring adaptation is triggered by non-scheduling DCI, application delay for SSSG switching is 25 OFDM symbols for , and 39 OFDM symbols for .***

***Proposal 14: When PDCCH monitoring adaptation is triggered by non-scheduling DCI, application delay for SSSG switching is 12 slots and 24 slots for respectively.***

***Proposal 15: When PDCCH monitoring adaptation is triggered by non-scheduling DCI, application delay for PDCCH skipping is 11 OFDM symbols for , and 25 OFDM symbols for .***

***Proposal 16: When PDCCH monitoring adaptation is triggered by non-scheduling DCI, application delay for PDCCH skipping is 8 slots and 16 slots for .***

## Lenovo, Motorola Mobility

1. R1-2111947 Enhanced DCI based power saving adaptation Lenovo, Motorola Mobility

**Proposal 1: When a UE is configured with 2 SSSGs and PDCCH skipping,**

* + **2-bit in scheduling DCI indicates PDCCH monitoring adaptation UE behaviors**
    - **‘00’ is Beh 2**
    - **‘01’ is Beh 2A**
    - **‘10’ is Beh 1A**
    - **‘11’ is reserved**

**Proposal 2: When a UE is configured with 3 SSSGs and PDCCH skipping,**

* + **2-bit in scheduling DCI indicates PDCCH monitoring adaptation UE behaviors**
    - **‘00’ is Beh 2**
    - **‘01’ is Beh 2A**
    - **‘10’ is Beh 2B**
    - **‘11’ is Beh 1A**

**Observation 1: Different search space switch timer values for SSSG 1 and SSSG 2 could increase the number of hypotheses on potential SSSG switching instances and could result in more ambiguity, when one or multiple DCI indicating SSSG switching are missed.**

**Proposal 3: When 2 or 3 SSSGs configured, one search space switch timer value is configured for a serving cell, as in Rel-16 NR.**

**Proposal 4: If a UE detects DCI indicating PDCCH skipping while running a search space switch timer, the UE continues running the search space switch timer.**

**Proposal 5: Reuse the Rel-16 application delay for K0,min/K2,min indication as an application delay for PDCCH skipping.**

**Proposal 6: Upon detecting a DCI format indicating PDCCH skipping, UE stops monitoring PDCCH in UE-specific search spaces and Type-3 common search spaces,**

* **not earlier than the application delay after the end of PDCCH including the indication, and**
* **for DL DCI format(s), upon expiration of *drx-RetransmissionTimerDL* if *drx-HARQ-RTT-TimerDL* or *drx-RetransmissionTimerDL* is running, and**
* **for UL DCI format(s), upon expiration of *drx-RetransmissionTimerUL* if *drx-HARQ-RTT-TimerUL* or *drx-RetransmissionTimerUL* is running.**

**Proposal 7: Rel-17 NR supports search space set switching when starting an ON duration timer in every DRX cycle based on DCI format 2\_6.**

## InterDigital, INC.

1. R1-2111962 PDCCH monitoring reduction in Active Time InterDigital, Inc.

**Proposal 1: For Case 4, support the following codepoint mapping:**

* **‘00’ is Beh 2 + Beh 1**
* **‘01’ is Beh 2A + Beh 1**
* **‘10’ is Beh 1A (in current SSSG)**
* **‘11’ is Beh 1A (in current SSSG)**

**Proposal 2: PDCCH skipping duration(s) are configured per SSSG.**

**Proposal 3: 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.**

**Proposal 4: Regarding application delay,**

* **For PDCCH skipping: Option f is supported. Application delay should be “ZERO” for PDCCH monitoring adaptation.**
* **For SSSG switching: Option b is supported. The application delay needed for PDCCH processing for Rel-16 minimum application delay for K0min/K2min indication is reused/extended**

**Proposal 5:** **PDCCH skipping indication is not applied in an interval when the DL/UL retransmission timer is running and PDCCH is monitored.**

**Proposal 6: If the UE switches to a null SSSG, PDCCH is monitored according to a configured/defines search space set while DL/UL retransmission timer is running.**

## ETRI

1. R1-2111992 Remaining issues on DCI-based power saving adaptation during DRX active time ETRI

**Proposal 1: Adopt the followings for the new DCI field indicating PDCCH monitoring adaptation:**

* **For Case 3 (i.e., 3 SSSG switching)**
  + **‘00’ is Beh 2**
  + **‘01’ is Beh 2A**
  + **‘10’ is Beh 2B**
  + **‘11’ is reserved**
* **For Case 4 (i.e., 2 SSSG switching with PDCCH skipping)**
  + **‘00’ is Beh 2**
  + **‘01’ is Beh 2A**
  + **‘10’ is Beh 1A with skipping duration 1**
  + **‘11’ is Beh 1A with skipping duration 2 (if M=2)**
* **For Case 5 (i.e., 3 SSSG switching with PDCCH skipping)**
  + **‘00’ is Beh 2**
  + **‘01’ is Beh 2A**
  + **‘10’ is Beh 2B**
  + **‘11’ is Beh 1A**

**Proposal 2: For Case 4 and Case 5, the SSSG timer runs independently with the PDCCH skipping duration. If the timer of the prior SSSG has expired at the end of the skipping duration, UE monitors the default SSSG. Otherwise, UE monitors the prior SSSG.**

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

**Proposal 4: PDCCH which does not schedule data and indicate SSSG switching or PDCCH skipping for an active BWP in active time is supported by DCI Format 1\_1 (SCell dormancy case 2 like).**

**Proposal 5: DCI format 2\_6 outside active time is supported to indicate SSSG switching or PDCCH skipping for an active BWP in active time when DRX is configured.**

**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.**

**Proposal 7: For DL scheduling DCI, at least in case where ACK/NACK is fed back, application timing of SSSG switching and PDCCH skipping comes after HARQ-ACK transmission timing + margin for gNB’s HARQ-ACK decoding processing time (Option d).**

**Proposal 8: For UL scheduling DCI, application timing of SSSG switching and PDCCH skipping comes after PUSCH transmission timing + margin for gNB’s PUSCH decoding processing time (Option c).**

**Proposal 9: 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.**

**Proposal 10: When the retransmission period, i.e., time period while DRX retransmission timer for PDSCH/PUSCH is running, is expected to occur, the application timing of SSSG switching and PDCCH skipping is configured to be after the retransmission period.**

## LG Electronics

1. R1-2112062 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 shut 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: For the bit mapping of DCI indication PDCCH monitoring adaptation for case 3, ‘11’ is Beh 1 or ‘no indication’.***

* ***SSSG switching timer is not affected by Beh 1.***

***Proposal 3: Bit mapping to the monitoring behavior and/or bit size of indication of monitoring adaptation can be differently configured for each DCI format.***

***Proposal 4: 0, 1, and 2 bit indication of monitoring adaptation can be configured for DCI format x\_2 via higher layer signal.***

***Observation 4: UE’s behavior after switching to ‘empty’ or ‘dormant’ 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’ or ‘dormant’ SSSG to other SSSG may not work properly.***

***Proposal 5: For SSSG which is configured to ‘empty’ or ‘dormant’, 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 6: Support skipping durations of {1…20, 40, 60, 80, 100ms} that are aligned with switching timer.***

***Proposal 7: Application delay enabling the UE and network to handle missing case of DCI indicating SSSG switching should be supported.***

***Proposal 8: Consider different application delay for two cases:***

* + ***Command applied after UE’s UL transmission (PUSCH or ACK) if monitoring adaptation is indicated by a DCI with scheduling information.***
  + ***Time-based application delay if monitoring adaptation is indicated by a DCI without scheduling information.***

***Proposal 9: Support PDCCH monitoring adaptation indicated by a DCI format 2\_6 inside/outside DRX Active Time.***

* + ***Discuss whether and how to define the monitoring window for DCI format 2\_6 inside DRX Active Time.***

***Proposal 10: 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***

## FGI, Asia Pacific Telecom

1. R1-2112075 Discussion on extension(s) to Rel-16 DCI-based power saving adaptation FGI, Asia Pacific Telecom

**Observation 1: A single PDCCH monitoring adaptation indication for multiple cells can reduce the signalling overhead of DCI.**

**Proposal 1: A single PDCCH monitoring adaptation indication for multiple cells should be supported.**

**Ovservation 2: Retransmission period defined by HARQ-ACK condition can only handle DL retransmission case well, but fail to deal with the UL retransmission case.**

**Proposal 2: After receiving a DCI indicating PDCCH skipping and/or switching to an empty SSSG, the UE**

* **does not perform PDCCH skipping when *drx-RetransmissionTimerDL(UL)* is running.**
* **switches out of the empty SSSG when *drx-RetransmissionTimerDL(UL)* is running.**

**Observation 3: For SR, the UE should monitor the PDCCH to receive the scheduling for UL grant. For RACH, the UE should monitor the PDCCH to receive the Msg2/Msg4/MsgB.**

**Observation 4: Since NW cannot predict the UE will trigger SR and CBRA, the explicit PDCCH monitoring adaptation indication by NW to switch out of the empty SSSG or to stop PDCCH skipping does not work.**

**Proposal 3: Implicit PDCCH monitoring adaptation for SR and RACH should be considered.**

## NTT DOCOMO, INC.

1. R1-2112118 Discussion on extension to DCI-based power saving adaptation NTT DOCOMO, INC.

**Proposal 1: We prefer to the revised Alt2/3 because those methouds can avoid any misalignment issue between gNB and UE in case of missing the DCI indication.**

**Proposal 2: The default SSSG when UE is indicated to monitor PDCCH within on-duration should be supported.**

**Proposal 3: At least in the case that the UE is configured cross-slot scheduling together with PDCCH skipping, we prefer to Option b.**

## Ericsson

1. R1-2112152 Design of active time power savings mechanisms Ericsson

[Proposal 1 Support *M* = 3 for PDCCH-skipping with 2 bits indication.](#_Toc87041586)

[Proposal 2 The following codepoints are used for Case 4 (2 SSSGs with PDCCH-skipping).](#_Toc87041587)

[- 00: Behaviour 1A for skipping duration T1, same SSSG](#_Toc87041588)

[- 01: Behaviour 1A for skipping duration T2, same SSSG (if T2 is configured)](#_Toc87041589)

[- 10: Behaviour 2 and no skipping](#_Toc87041590)

[- 11: Behaviour 2A and no skipping](#_Toc87041591)

[Proposal 3 For PDCCH-skipping, the skipping durations are configured per BWP.](#_Toc87041592)

[Proposal 4 For PDCCH-skipping, the skipping duration is defined in units of slots (including half-slot) of the currently active BWP of the cell in which PDCCH monitoring behavior is being adapted.](#_Toc87041593)

[Proposal 5 Support the following for PDCCH-skipping durations:](#_Toc87041594)

[{0.5, 1, 2, … 20, 40, 60, 80, 100} for 15kHz SCS,](#_Toc87041595)

[{0.5, 1, 2, … 40, 80, 100, 160, 200} for 30kHz SCS,](#_Toc87041596)

[{0.5, 1, 2, … 80, 160, 200, 320, 400} for 60kHz SCS, and](#_Toc87041597)

[{0.5, 1, 2, … 160, 320, 400, 640, 800} for 120kHz SCS](#_Toc87041598)

[Proposal 6 For SSSG-switching, the switching timer can be configured per non-default SSSG.](#_Toc87041599)

[Proposal 7 For Rel. 17 PDCCH monitoring adaptation, following extended value range of SSSG switching timer (compared to Rel-16) is supported.](#_Toc87041600)

[- {1…20, 40, 60, 80, 100} for 15 kHz SCS,](#_Toc87041601)

[- {1...40, 80, 100, 160, 200} for 30 kHz SCS,](#_Toc87041602)

[- {1…80, 160, 200, 320, 400} for 60kHz SCS, and](#_Toc87041603)

[- {1…160, 320, 400, 640, 800} for 120kHz SCS](#_Toc87041604)

[Proposal 8 Support intercell indication for PDCCH monitoring adaptation with DCI 1-1 for P(S)Cell, at least for the case like case 2 dormancy indication and using a new RNTI configured by higher layers.](#_Toc87041605)

[Proposal 9 For a cell for which PDCCH monitoring can be adapted, it should be possible to support different number of bits for same cell indication and intercell indication (e.g., 2-bits for indication on same cell and 1-bit for intercell indication from another cell).](#_Toc87041606)

[Proposal 10 For a cell for which PDCCH monitoring can be adapted, it should be possible to independently configure same cell indication and intercell indication.](#_Toc87041607)

[Proposal 11 Higher layers can configure the PDCCH monitoring adaptation indication bits to be present only in the DL scheduling DCI, UL scheduling DCI, or both DL scheduling DCI and UL scheduling DCI.](#_Toc87041608)

[Proposal 12 For case 1 (Beh 1), a '0' or ‘00’ value for the bit indicates no skipping indicated in the corresponding DCI for PDCCH monitoring.](#_Toc87041609)

[Proposal 13 For a transition between non-default SSSGs (e.g., SSSG1 or SSSG2) and SSSG0 triggered by switching timer expiration, a similar mechanism with Rel. 16 SSSG-switching feature is adopted.](#_Toc87041610)

[Proposal 14 The SSSG timer is reset when UE receives a PDCCH with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI.](#_Toc87041611)

[Proposal 15 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.](#_Toc87041612)

[Proposal 16 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.](#_Toc87041613)

[Proposal 17 The minimum application delay from Rel. 16 SSSG-switching feature can be used as the minimum application delay for Rel. 17 SSSG-switching. Delay for 120 kHz SCS is [25] symbols.](#_Toc87041614)

[Proposal 18 For SSSG-switching indicated via scheduling DCI format 1-1/1-2, UE applies switching command (i.e., to the indicated SSSG) after transmitting HARQ-ACK feedback.](#_Toc87041615)

[Proposal 19 For SSSG-switching indicated via scheduling DCI format 0-1/0-2, UE applies the switching command (i.e., to the indicated SSSG) after an RRC configured delay. If the timer is not configured, the minimum application delay for SSSG switching applies.](#_Toc87041616)

[Proposal 20 For PDCCH-skipping via scheduling DCI format 1-1/1-2, UE applies the skipping immediately after the UE receives the indication (e.g. next symbol/slot). If the UE fails to decode the PDSCH (and transmits a NACK), the skipping is canceled in the slots after the NACK transmission (if any).](#_Toc87041617)

[Proposal 21 For PDCCH-skipping indicated via scheduling DCI format 0-1/0-2, UE applies the skipping command after an RRC configured delay expires. If the timer is not configured, the UE applies the PDCCH-skipping immediately.](#_Toc87041618)

[Proposal 22 PDCCH monitoring adaptation for Rel. 17 should not entail an interruption to UE transmission/reception on any serving cell.](#_Toc87041619)

## Qualcomm Incorporated

1. R1-2112229 DCI-based power saving adaptation during DRX ActiveTime Qualcomm Incorporated

Observation 1: Regarding the DCI codepoint mappings suggested in RAN1 #106bis-e:

* **The mappings for Alt 1 and Alt 3a are not self-contained and may suffer from misdetection of DCI indication.**
* **The mappings for Alt 2 and Alt 3 are self-contained and robust to misdetection of DCI indication.**

Proposal 1: If two SSSGs (i.e., default and non-default SSSGs) are configured, the default SSSG is associated with sparse PDCCH monitoring and the non-default SSSG is associated with dense PDCCH monitoring. The indication of Beh 1A is allowed only on the non-default SSSG (Alt 3).

Proposal 2: For PDCCH monitoring adaptation Case 4 (2 SSSG switching with PDCCH skipping), one or both of the followings are supported:

* Alt 2: *M* = 1
  + **‘00’ is Beh 2 and Beh 1**
  + **‘01’ is Beh 2A and Beh 1**
  + **‘10’ is Beh 2 and Beh 1A for duration T**
  + **‘11’ is Beh 2A and Beh 1A for duration T**
* **Alt 3: *M* = 2**
  + **‘00’ is Beh 2 and Beh 1**
  + **’01’ is Beh 2A and Beh 1**
  + **‘10’ is Beh 2A and Beh 1A for duration T1**
  + **‘11’ is Beh 2A and Beh 1A for duration T2**

Proposal 3: By a single DCI indication, a UE is not expected to simultaneously perform two behaviors of SSSG switching and PDCCH skipping.

Proposal 4: The PDCCH skipping duration should be larger than the application delay of SSSG switching and no larger than the SSSG timer value.

Proposal 5: For PDCCH skipping, indication to skip the current DRX cycle, if DRX is configured, is not supported.

Proposal 6: The PDCCH skipping duration is configured per BWP, regardless of whether SSSGs are configured.

Proposal 7: For the application delay of PDCCH monitoring adaptation,

* **SSSG switching:**
  + **Option a, if minimum scheduling offset restriction is not configured,**
  + **Max{Option a, Option b}, otherwise.**
* **PDCCH skipping: Option f**
  + **DL/UL HARQ retransmission during the skipping duration is handled by RTT/ReTx timers.**

Proposal 8: For explicit indication of PDCCH monitoring adaptation, in addition to scheduling DCI formats 0\_1/1\_1/0\_2/1\_2, non-scheduling DCI formats are also considered:

* DCI format 1\_1 (similar to Case 2 SCell dormancy indication),
* DCI format 2\_6 (outside active time).

Proposal 9: For implicit indication of PDCCH monitoring adaptation, the following candidates are considered:

* **Configured timer: per-non-default SSSG, if more than two SSSGs are supported,**
* **Transmission of SR and PRACH: terminate a PDCCH skip duration after transmitting a scheduling request or a PRACH preamble.**

Proposal 10: In the CA scenario, for the joint adaptation across CCs, carrier-group-based PDCCH monitoring adaptation is considered.

## MediaTek Inc.

1. R1-2112310 On enhancements to DCI-based UE power saving during DRX active time MediaTek Inc.

**Proposal 1: Monitoring PDCCH scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI for Type 0/1/1A/2 CSS in Beh 1A is not supported.**

**Proposal 2: Support slot as the unit of X in Beh 1A.**

**Proposal 3: To avoid duplicated functionality of MAC-CE, not support skipping current DRX cycle when DRX is configured.**

**Proposal 4: Support skip duration configuration per BWP**

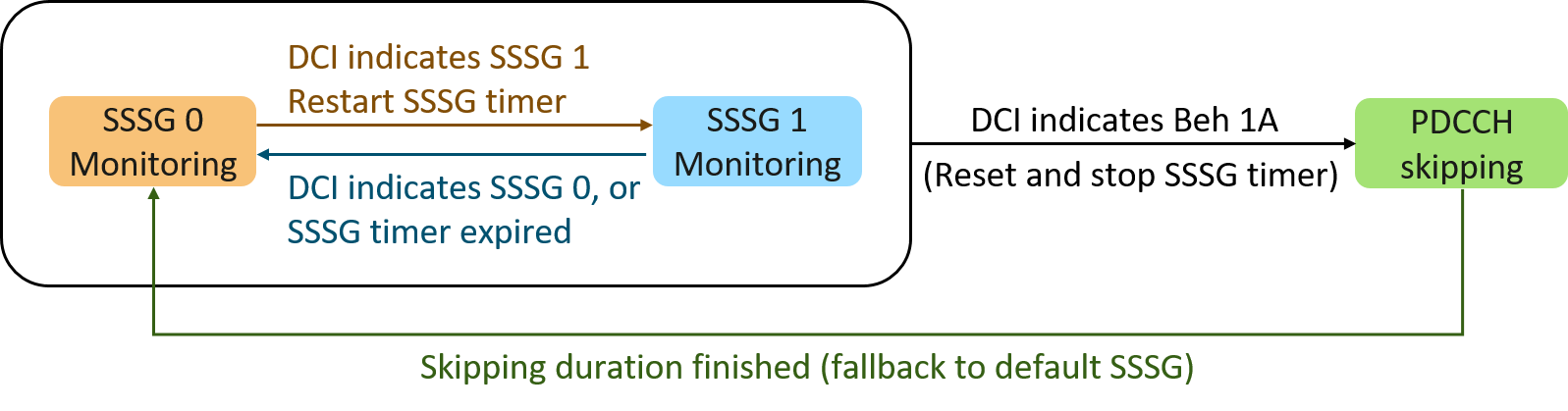
**Proposal 5: If there is no SS associated to the SSSG, a timer is configured for UE to switch back to the default SSSG.**

**Proposal 6: Support Alt 3, the SSSG timer value is common and configured per BWP.**

**Proposal 7: UE skips PDCCH monitoring for an indicated duration on current SSSG when receiving indication of Beh 1A.**

**Proposal 8: If SSSG switching and PDCCH skipping, i.e., Beh 2/2A/[2B] and Beh 1A, are both configured, UE always fallbacks to default SSSG, i.e., SSSG #0, after skipping duration expires.**

**Proposal 9: Reset and Stop the SSSG timer when UE receives the skipping indication.**



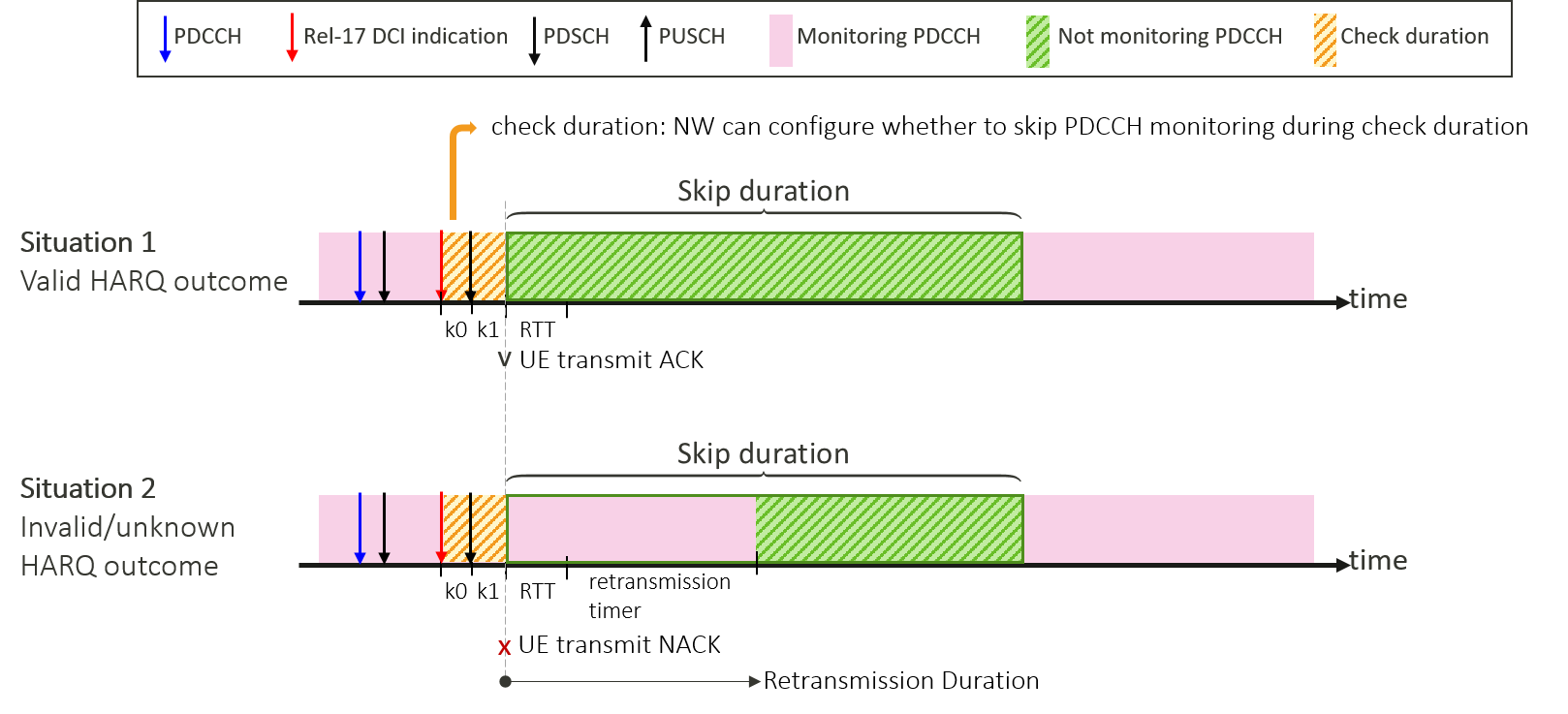
**Figure 1. State machine of interaction between PDCCH skipping and SSSG switching**

**Proposal 10: Prioritize completing the design based on scheduling DCI.**

**Proposal 11: Retransmission handling is based on extended application delay.**

**Proposal 12: Application delay includes a check duration where the UE determines whether to handle the retransmission.**

* + **The check duration can be set as the time length of k0 + k1 in downlink.**
  + **The check duration can be set as the time length of k2 in uplink.**

****

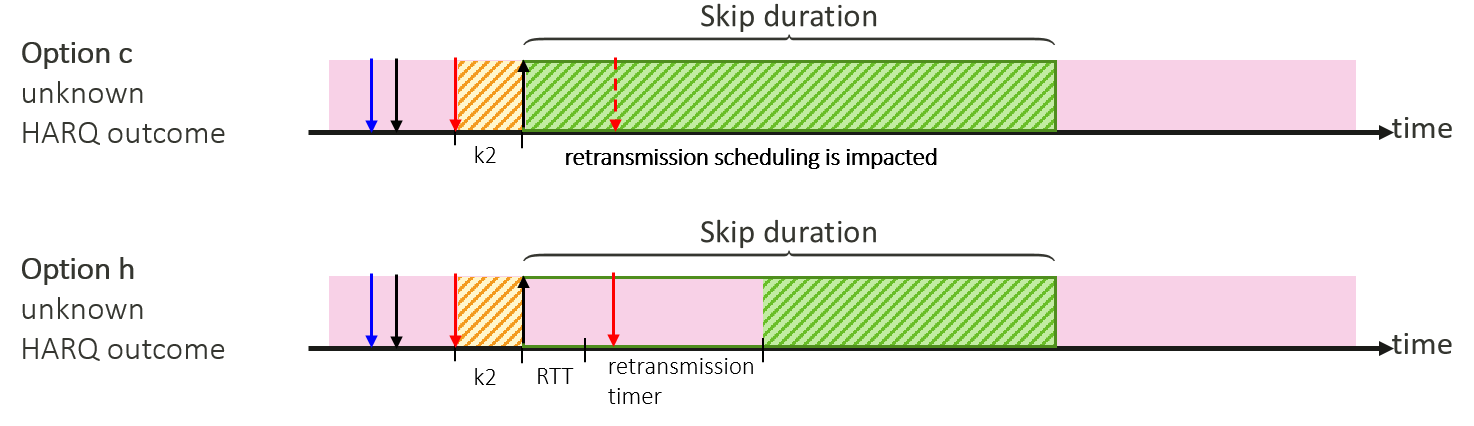
**Figure 2. Introduce a check duration where the UE determines whether to handle the retransmission.**

**Proposal 13: Network can configure whether UE needs to monitor PDCCH during the check duration.**

**Proposal 14: The skip duration of PDCCH skipping always starts to count at the end of check duration.**

**Observation 1: Option c for uplink cannot resolve the retransmission issue.**

**Proposal 15: For PDCCH skipping, support option d for downlink scheduling, option h for uplink scheduling.**



**Figure 3. Option c cannot handling the retransmission issue for uplink**

**Proposal 16: For SSSG switching, extend the original application delay by including the check duration and, if HARQ outcome is NACK, additional retransmission duration. This is equivalent to select:**

* **Option d for downlink scheduling**
* **Option h for uplink scheduling**

## Nokia, Nokia Shanghai Bell

1. R1-2112372 Open issues on PDCCH monitoring adaptation for UE power saving Nokia, Nokia Shanghai Bell

**Proposal: Determine the 3 SSSG switching and skipping as follows:**

**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**

**Observation:** *Assuming that, for both SSSG switching and stopping PDCCH monitoring, upon timer expiry UE shall return to default SSSG, streamlines, and simplifies the operation.*

**Proposal: Upon expiry of the PDCCH skipping duration or SSSG switching timer, UE should return to default SSSG.**

**Proposal: Determine the 2 SSSG switching and skipping with one duration as follows:**

**For Case 4 (i.e., 2 SSSG switching and two skipping durations)**

* **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 1A**
  + **‘11’ is reserved**

**Proposal: Determine the 2 SSSG switching and skipping with one duration as follows:**

* **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 1A with duration T1**
  + **‘11’ is Beh 1A with duration T2**

**Proposal: Support configuration of higher layer parameter searchSpaceSwitchTrigger-r17 to DCI format 2\_0 is configured so that DCI format 2\_0 can be used to indicate the SSSG to be monitored.**

**Observation:** *Consider supporting additional non-scheduling DCI via DCI format 1\_1 for PDCCH monitoring adaptation.*

In Section 2.2 we looked the timer based adaptation and related configurations and concluded as follows:

**Observation*:*** *If the signalling field size is to be reduced for SSSG switching timer, we could consider increase the granularity for the lower range e.g. to slot values corresponding to {[1, 2, 4, 5, 8, 10, 14, 15, 16, 20], 40, 60, 80, 100}ms.*

**Observation:** *Configuration for the duration for the skipping PDCCH monitoring is affected by the allowed traffic latency and other traffic KPIs, which are not dependent on the SSSG.*

**Proposal**: **Configurations for PDCCH skipping durations and SSSG switching timers can be done in BWP specific manner.**

**Proposal**: **Support configuring up to two PDCCH skipping durations, i.e. M=2.**

**Proposal: Support configuring skipping duration as a function of slots. The range could be defined as follows:**

* **{1,2,3,4,5,8,10,12,15,20} slots for 15kHz**
* **{1,2,4,8,10,12,16,20,30,40} slots for 30kHz**
* **{1,2,4,8,10,16,20,30,40,80} slots for 60kHz**
* **{2,4,8,10,16,20,30,40,60,80} slots for 120kHz**

**Proposal: If UE receives scheduling or non-scheduling DCI indicating no SSSG switch (i.e. field value corresponds to the active SSSG#1 or #2), UE resets the SSSG switching timer.**

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

In Section 2.3 we considered other open aspects related to the PDCCH monitoring adaptation:

**Proposal:** **Procedures such as SR transmission, BSR or beam failure recovery should result UE to stop PDCCH monitoring adaptation and resume normal PDCCH monitoring (i.e. stop PDCCH skipping and/or change to default SSSG).**

**Proposal: Use the application delay timeline introduced in Rel-16 for SSSG switching i.e. option a). For µ=3 define Pswicth capability {1,2} as {25,22}.**

**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 scheduling, but scheduling can follow the applied SS set(s).*

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

**Proposal: For stopping PDCCH monitoring based on PDCCH skipping, assume either that skipping is not applied until successful decoding or UL transmissions are not pending or alternatively define timers similarly as in C-DRX operation to enable configuring time windows for handling the open re-transmissions.**

**Proposal:** **Consider support configuring of SSSG that is applied at the start of the On Duration.**

**Proposal: Do not support duplicating DRX Command MAC-CE or Long DRX Command MAC-CE with PDCCH monitoring adaptation.**

**Observation:** *Associating minimum cross-slot scheduling restriction to certain SSSGs could be considered.*

**Proposal**: Confirm the working assumption that 3 SSSGs are supported:

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

## Nordic Semiconductor ASA

1. R1-2112381 On PDCCH monitoring adaptation Nordic Semiconductor ASA

***Proposal-1:*** *Support at most two skipping durations, maximum M=2.*

***Proposal-2:*** *Skipping duration maximum value is 20ms, minimum value is 1slot, and it is configured in slots per BWP.*

***Observation-1:*** *Ambiguity caused by different initial timer values for non-default SSSGs can be handled by gNB implementation, for example by*

* *Configuring SSSGs with nested Monitoring occasions (MOs)*
* *Depending on ACK/NACK transmitting re-tx-PDCCH to a MO common to both non-default SSSGs*

***Proposal-3:*** *Support Alt 1: Separate RRC configuration for initial timer value(s) is supported for switching from SSSG#2 to SSSG#0 and from SSSG#1 to SSSG#0 respectively. Timer initial values are configured per BWP.*

* *Note gNB may configure values to be the same for non-default SSSGs.*

***Proposal-4:*** *Consider support for a dormancy SSSG, the non-default SSSG configured with sparse MOs, where monitoring of all or subset of group’s search-space sets is conditional on a pending re-transmission.*

***Proposal-5****: 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,* 
  + *00: Beh 2*
  + *01: Beh 2 + Beh 1A skipping duration 1*
  + *10: Beh 2A*
  + *11: Beh 2A + Beh 1B skipping duration* 2

***Proposal-6:*** *UE expects that for each indicated codepoint, a SSSG timer initial value is always greater than the skipping duration.*

***Proposal-7:*** *Focus on finalizing single-cell indication case before discussing multi-cell indication case.*

***Proposal-8:*** *Presence of DCI field in DCI format X\_1 and X\_2 is separately configurable.*

***Proposal-9:*** *For application delay,**select Option-a for SSSG group switching and select Option-i for PDCCH skipping.*

***Proposal-10****: UE does not expect to receive PDCCH in USS or TYPE-3 after PDCCH indicating skipping duration and until the end of that indicated duration.*

## Fraunhofer HHI, Fraunhofer IIS

1. R1-2112397 DCI-based Power Saving Enhancements Fraunhofer HHI, Fraunhofer IIS

**Proposal 1: For Case 4, the codepoints of the indication in DCI shall be RRC-configurable from one the behavior set (1A-1/1A-2/1A-3/2/2A/2B).**

**Proposal 2: SSSG Fallback timers shall be configurable per SSSG.**

**Proposal 3: If cross-slot scheduling is configured, joint indication of SSG switching and minimum offset adaptation shall be supported.**

**Proposal 4: The PDSCH processing time shall be adaptable based on certain parameters, e.g., the minimum scheduling offset or the currently active SS group.**

# 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#107-E in AI 8.7.2,**

1. R1-2110840 Extensions to Rel-16 DCI-based power saving adaptation for an active BWP Huawei, HiSilicon
2. R1-2110940 Extension to Rel-16 DCI-based power saving adaptation during DRX Active Time ZTE, Sanechips
3. R1-2111026 Remaining issues on DCI-based power saving adaptation in connected mode vivo
4. R1-2111105 Discussion on power saving techniques for connected-mode UEs Spreadtrum Communications
5. R1-2111181 Discussion on DCI-based power saving adaptation NEC
6. R1-2111269 PDCCH monitoring adaptation CATT
7. R1-2111327 DCI-based power saving adaptation solutions OPPO
8. R1-2111506 Discussion on DCI-based power saving adaptation in active time Intel Corporation
9. R1-2111619 Discussion on PDCCH monitoring reduction during DRX active time CMCC
10. R1-2111677 Potential extension(s) to Rel-16 DCI-based power saving adaptation during DRX ActiveTime Panasonic
11. R1-2111750 Discussion on DCI-based power saving techniques Samsung
12. R1-2111886 Enhanced DCI-based power saving adaptation Apple
13. R1-2111947 Enhanced DCI based power saving adaptation Lenovo, Motorola Mobility
14. R1-2111962 DCI-based power saving adaptation during DRX Active Time InterDigital, Inc.
15. R1-2111992 Remaining issues on DCI-based power saving adaptation during DRX active time ETRI
16. R1-2112062 Discussion on DCI-based power saving adaptation during DRX ActiveTime LG Electronics
17. R1-2112075 Discussion on extension(s) to Rel-16 DCI-based power saving adaptation FGI, Asia Pacific Telecom
18. R1-2112118 Discussion on extension to DCI-based power saving adaptation NTT DOCOMO, INC.
19. R1-2112152 Design of active time power savings mechanisms Ericsson
20. R1-2112229 DCI-based power saving adaptation during DRX ActiveTime Qualcomm Incorporated
21. R1-2112310 On enhancements to DCI-based UE power saving during DRX active time MediaTek Inc.
22. R1-2112372 Open issues on PDCCH monitoring adaptation for UE power saving Nokia, Nokia Shanghai Bell
23. R1-2112381 On PDCCH monitoring adaptation Nordic Semiconductor ASA
24. R1-2112397 DCI-based Power Saving Enhancements Fraunhofer HHI, Fraunhofer IIS

**Other references:**

1. RP-200938, “Revised WID: UE Power Saving Enhancements for NR”, MediaTek Inc., RAN#88-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)