3GPP TSG-RAN2 Meeting #119-e R2-2209012

eMeeting, 15-26 August 2022

Agenda Item: 8.9.2.2 Control and Procedure details

Source: Ericsson

Title: Summary of [AT119-e][028][ePowSav] PDCCH Skip

Document for: Discussion and Decision

# Introduction

This report provides a summary of the following offline discussion:

* [AT119-e][028][ePowSav] PDCCH Skip (Ericsson)

Scope: Treat [R2-2208090](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119-e/Docs/R2-2208090.zip), Determine agreeable parts. Capture agreeable part in MAC CR.

Can do one more round of treatment for [R2-2208089](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119-e/Docs/R2-2208089.zip), identify critical arguments if any, prepare for CB.

Intended outcome: Report, Agreed MAC CR

Deadline: In time for online CB W2 Thu if required otherwise EOM

The deadline for providing comments is **10:00 UTC Wednesday 24th August** so that it is possible to comeback online, if needed.

# Contact information

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# Discussion

## PDCCH skipping in 38.300 and 38.321 ([R2-2208089](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_119-e/Docs//R2-2208089.zip))

The following motivation is provided to clarify PDCCH skipping in 38.321 [1]:

*Some companies preferred to avoid any impact of PDCCH skipping on 38.321, i.e. 38.321 only refers to 38.213 specification without mentioning PDCCH skipping:*

*2> monitor the PDCCH on the Serving Cells in this DRX group as specified in TS 38.213 [6];*

*Dormant BWP, similar as PDCCH skipping, is a L1 function which does not impact Active Time. However the UE is not required to monitor PDCCH on a dormant BWP, which is captured in 38.321:*

***Dormant BWP:*** *The dormant BWP is one of downlink BWPs configured by the network via dedicated RRC signaling. In the dormant BWP, the UE stop monitoring PDCCH on/for the SCell, but continues performing CSI measurements, Automatic Gain Control (AGC) and beam management, if configured.*

**Proposal 1**: Clarify in 38.321 that when PDCCH skipping is configured by RRC the UE does not monitor PDCCH for a duration as specified in TS 38.213:

When PDCCH skipping is configured by RRC the UE does not monitor PDCCH for a duration as specified in TS 38.213 [6].

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| **Company** | **Yes/No** | **Comments** |
| Ericsson | Yes (proponent) | We think that the readability of 38.321 is improved with this minor clarification, i.e. the reader is informed that the Active Time is not the only function that determines whether the UE is required to monitor PDCCH. |
| vivo | No | In our understanding, the text “monitor the PDCCH on the Serving Cells in this DRX group as specified in TS 38.213” includes the case for PDCCH skipping.  We are not sure about the motivation for this change. Anything missing in TS 38.321 or TS 38.213? If this is already clear in TS 38.213, we prefer not to capture duplicated description in TS 38.321. We would like to hear more justification for this change. |
| CATT | No | We agree with vivo. The reference to 38.213 already covers that. If possible, we would prefer to keep PDCCH skipping feature in RAN1 spec only. |
| OPPO | No | We think it is already clearly captured in TS 38.213. PDCCH skipping mechanism is invisible to MAC, so no need to capture it in MAC spec. |
| Huawei, HiSilicon | No | We agree with vivo. |
| LGE | No | We don’t see any problem with the current MAC specification without this clarification. |
| ZTE | No | Agree with vivo. |
| Nokia | - | No strong view, current text seems to be clear enough saying monitoring PDCCH as specified in 38.213. |
| Xiaomi | - | No strong view. Current text is OK. |
| Intel | - | No strong view. The current reference to 38.213 seems sufficient. |
| MediaTek | - | "When PDCCH skipping is configured by RRC the UE does not monitor PDCCH for a duration as specified in TS 38.213 [6]"  => This sentence is strange. Since PDCCH skipping is triggered by DCI, UE doesn't skip per RRC configuration. Suggest to revise as below:  "When PDCCH skipping is configured by RRC **and is indicated via DCI,**the UE does not monitor PDCCH for a duration as specified in TS 38.213 [6]." |
| Qualcomm | - | No strong view. If companies decide to add clarification to 38.321, we prefer the TP from MediaTek. |
| CMCC | - | No strong view. Current text looks good to us. |
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**Summary:** (7/13) companies indicated to see no reason for clarification. (5/13) companies had no strong view. Proponent company thinks that the readability would be improved.

**Rapporteur:** The rapporteur confirms that the specification is not incomplete, and there is not sufficient support to improve the readability as suggested.

**Proposal-1:** PDCCH skipping is not further clarified in 38.321.

The following motivation is provided to move the stage 3 requirements for PDCCH skipping from 38.300 to 38.321 [1]:

*PDCCH skipping is a L1 function (captured in section 10.4 in 38.213) that is configured via L3 (see pdcch-SkippingDurationList in 38.331) using UE capability (see pdcch-SkippingWithoutSSS and pdcch-SkippingWithSSSG in 38.306).*

*There is a stage 2 description in chapter 11 in 38.300:*

*UE power saving may also be achieved through PDCCH monitoring adaptation mechanisms when configured by the network, including skipping of PDCCH monitoring and Search space set group (SSSG) switching. In this case UE does not monitor PDCCH during the PDCCH skipping duration or monitors PDCCH according to the search space sets applied in SSSG. However, in the following cases, UE ignores PDCCH skipping:*

*- on all serving cells of the corresponding Cell Group when SR is sent and is pending;*

*- on SpCell while contention resolution timer is running;*

*- on SpCell during monitoring of the RAR/MsgB window.*

*However these stage 3 details are typically not captured in 38.300.*

**Proposal 2**: Move the following stage 3 requirements from 38.300 to 38.321:

However, in the following cases, UE ignores PDCCH skipping:

- on all serving cells of the corresponding Cell Group when SR is sent and is pending;

- on SpCell while contention resolution timer is running;

- on SpCell during monitoring of the RAR/MsgB window.

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| **Company** | **Yes/No** | **Comments** |
| Ericsson | Yes (proponent) | These are stage 3 requirements that belong in 38.321. |
| vivo | No | This issue was discussed in RAN2#117e meeting. In that meeting, an LS was sent to RAN1 with below question:  ***Question 2:*** *RAN2 would like to know if RAN1 prefers to capture the above agreements in RAN1 specification or prefer these to be captured in MAC specification.*  In RAN2#118e meeting, there is a reply LS R2-220446/R1-2202905 from RAN1. It is clearly said:  ***Answer 2:***  *RAN1 would discuss and conclude how to capture the above RAN2 agreements in RAN1 specification.*   * *It is RAN1 understanding PDCCH skipping is not applied to perform PDCCH monitoring during RAR window/MsgB window/contention resolution timer or when SR is pending.*   As far as I know, this part has been already captured in RAN1 specification (TS 38.213). We prefer not to capture any duplicated description in both RAN1 and RAN2 specifications. |
| CATT | No | We agree this is stage 3 description but also agree with vivo that we would prefer to keep it captured in RAN1 spec. |
| OPPO | Yes | OPPO |
| Huawei, HiSilicon | No | For stage 3 description, we understand all will be captured in RAN1 spec, so this part does not need to be duplicated in MAC spec. |
| LGE | No | Agree with Vivo. Considering that PDCCH skipping is RAN1 feature, if something is needed, details should be captured in RAN1 specification. Thus, TS38.300 should be sufficient for this. |
| ZTE | Yes | According to our RAN1 colleague, the RAN 1 work for capturing such part is pending for a long time. If RAN1 cannot do this, we agree with RAN2 to do that. |
| Nokia | Yes | Ok with moving to stage 3, it should be modified to “the UE shall…” |
| Xiaomi | No | RAN1 is discussing how to capture this in their spec, so current TS 38.300 is Ok |
| Intel | No strong view | Since these are related to PDCCH skipping and is in RAN1 scope, it is expected that RAN1 will include this. But if they don’t, then we can include them in our Stage-3 spec and remove it from 38.300 |
| MediaTek | No | Given whether to allow UE to skip next DRX on-duration can be up to network configuration, there seems no need to include addition interaction between MAC (DRX active time) and L1 (PDCCH skipping). RAN2 may wait for RAN1 decision for Aug meeting. |
| Qualcomm | - | No strong view |
| CMCC | - | No strong view. Could further modify if we receive the LS from RAN1. |
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**Summary:** (7/13) companies think that RAN1 is discussing these use cases, and RAN1 might capture those agreements in RAN1 specification. Other companies think it might be good to move these requirements to 38.321.

**Rapporteur:** It seems that RAN1 is discussing the same use cases that RAN2 discussed before and captured in 38.300, see link to latest RAN1 discussion document below. Based on the outcome of this discussion, RAN1 can be expected to capture the agreements in 38.213. The rapporteur thinks that we should not duplicate the same requirements in 38.213 and 38.300. So let’s wait for the outcome in RAN1, and check/discuss later if any update to 38.300 is needed.

[R1-220XXXX\_Draft summary#1 for maintenance on UE power saving\_enhancements\_2nd\_Rnd\_v01\_Moderator\_Nordic.docx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110/Inbox/drafts/8.7(NR_UE_pow_sav_enh)/2nd_Rnd/R1-220XXXX_Draft%20summary%231%20for%20maintenance%20on%20UE%20power%20saving_enhancements_2nd_Rnd_v01_Moderator_Nordic.docx)

**Proposal-2:** Wait for RAN1 outcome and postpone update of PDCCH skipping in 38.300.

A draft CR for 38.321 is provided for information.

## Configuration of PDCCH skipping and C-DRX ([R2-2208089](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_119-e/Docs//R2-2208089.zip))

In [2] it is proposed that PDCCH monitoring skipping can only be configured when C-DRX is configured. There is some history on this topic, which is presented first for information [2]:

**History**

*The WID clearly states that PDCCH monitoring adaptation is only used when C-DRX is configured [3]:*

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]*

*In RAN2#118-e it was discussed whether PDCCH monitoring adaptation can only be configured when C-DRX is configured [4, 5], but most companies preferred to leave this decision to RAN1 [6]:*

***Summary****: 12 out of 14 companies prefer to wait for RAN1 conclusion.*

***Proposal 4 (12 out of 14): Whether PDCCH monitoring adaptation mechanisms can only be configured when DRX is configured is up to RAN1.***

*Configuration of PDCCH monitoring adaptation and C-DRX was discussed during RAN1#109-e [7]:*

***Proposal 8: As the work item determines the scope to be DRX Active Time, it should be confirmed that Rel-17 PDCCH monitoring adaptation is configured only together with C-DRX.***

*In email discussion PowSav-02 [8] all companies, except the proponent, indicated to disagree that this is an issue and that this does not need to be discussed:*

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| *14* | *Adding restriction to Rel-17 PDCCH monitoring adaptaion which can be only used when C-DRX is configured.* | *[13, Nokia, P8]* | *[13, Nokia, P9]* |

***Please provide your view below. “Y” to acknowledge it is an issue and need to discuss, “N” to disagree it is an issue and not need to discuss.***

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| --- | --- |
| ***Company*** | ***14*** |
| *Huawei* | *N* |
| *Spreadtrum* | *N* |
| *CATT* | *N* |
| *vivo* | *N* |
| *ZTE* | *N* |
| *xiaomi* |  |
| *Samsung* |  |
| *OPPO* |  |
| *Panasonic* |  |
| *Apple* |  |
| *DOCOMO* |  |
| *Nokia* | *Y* |
| *LG* | *N* |
| *MediaTek* | *N* |
| *Nordic* | *N* |
| *Intel* | *N* |
| *InterDigital,* |  |
| *Ericsson* |  |
| *Qualcomm* |  |

**Motivation and proposal**

In [2] the following motivation is provided to configure PDCCH skipping only when C-DRX is configured:

***Observation 1****: If C-DRX is not configured, and a short skipping duration is configured then the NW has to frequently send skipping commands via DCI to enable power saving in the UE when there is no traffic, which increases the NW power consumption.*

***Observation 2****: When PDCCH skipping without C-DRX it is expected to perform worse from a UE power saving perspective compared to C-DRX without PDCCH skipping because with long sleep periods the UE needs to constantly wake-up.*

***Observation 3****: PDCCH skipping is not an alternative for C-DRX but it can complementary enable micro sleep*

**Proposal 3**: Capture in 38.331 that PDCCH monitoring adaptation can only be configured when C-DRX is configured.

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| **Company** | **Yes/No** | **Comments** |
| Ericsson | Yes (proponent) | For both UE and NW products C-DRX is the baseline for UE power saving, and we would not like to change this.  We also only see negative effects if PDCCH monitoring can be configured without C-DRX. |
| vivo | No | As rapporteur mentioned, this issue was discussed in RAN2#118e meeting:  ***Proposal 4 (12 out of 14): Whether PDCCH monitoring adaptation mechanisms can only be configured when DRX is configured is up to RAN1.***  PDCCH skipping is a RAN1 led feature, and all designs are determined in RAN1. If companies proposed to restrict PDCCH skipping into C-DRX, how about SSSG switching? Should the same restriction be introduced? We think it is better to leave RAN1 to make such restriction for either PDCCH skipping or SSSG switching.  In our understanding, this issue was discussed in RAN1 (with no consensus) and will be further discussed in this meeting. We should avoid the duplicated discussion between RAN1 and RAN2.  We have different views with rapporteur on observation 1 and 2. Even in study phase, we don’t identify the pros to introduce the restriction or cons to not introduce the restriction. Thus, from RAN2 perspective, we don’t see motivation to have such restriction.  Anyway, it is up to network configuration whether/how to configure PDCCH skipping with C-DRX. Thus, there is no need to capture anything addition in RAN2 specification. |
| CATT | Yes | In absence of clear conclusion from RAN1 we are OK to follow the WID. |
| OPPO | No | C-DRX and PDCCH skipping are separate features. It is up to NW to decide whether to configure PDCCH skipping together with C-DRX, we see no need to introduce such configuration restriction. |
| Huawei, HiSilicon | No | There is no clear conclusion in RAN1 that PDCCH monitoring adaptation is configured only together with C-DRX, and there is no such restriction in current RAN1 spec. For the possible negative effects of combination, anyway it is up to NW configuration, NW can decide which function(s) to use considering UE power saving and NW power consumption / signalling overhead. |
| LGE | No | RAN2 should follow the previous RAN2 agreement which indicates that it is up to RAN1, so we should wait the RAN1 final decision in this meeting. No need to rush unless RAN1 makes clear conclusion. |
| ZTE | No | It seems RAN1 discussion is still ongoing. |
| Nokia | Yes | Agree with Ericsson/CATT. |
| Xiaomi | - | No strong view since RAN1 is discussing this. |
| Intel | No | Wait for RAN1 discussion. |
| MediaTek | No | RAN1 discussion is still ongoing. |
| Qualcomm | No | It can be left to network configuration. |
| CMCC | No | Wait for RAN1’s conclusion. |
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**Summary:** (10/13) companies think that PDCCH skipping can be configured without C-DRX for different reasons (e.g. RAN1 is still discussing or this can be left to NW configuration). (3/13) companies think that PDCCH skipping can only be configured if C-DRX is configured.

**Rapporteur:** RAN1 already agreed that PDCCH skipping is only applicable during Active Time (RAN1#109-e):

Agreement

Down-select from the followings,

Alt-1

The PDCCH skipping applies only in active time. The PDCCH skipping duration decrements by slot irrespective whether UE is in active time or not

Alt-2

The PDCCH skipping applies only in active time. PDCCH skipping is terminated when UE goes into outside active time.

RAN1 is only discussing whether the timer keeps running or is stopped after Active Time:

[R1-220XXXX\_Draft summary#1 for maintenance on UE power saving\_enhancements\_2nd\_Rnd\_v01\_Moderator\_Nordic.docx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110/Inbox/drafts/8.7(NR_UE_pow_sav_enh)/2nd_Rnd/R1-220XXXX_Draft%20summary%231%20for%20maintenance%20on%20UE%20power%20saving_enhancements_2nd_Rnd_v01_Moderator_Nordic.docx)

Active Time is only applicable when C-DRX is configured as specified in 38.321:

When DRX is configured, the Active Time for Serving Cells in a DRX group includes the time while:

- *drx-onDurationTimer* or *drx-InactivityTimer* configured for the DRX group is running; or

- *drx-RetransmissionTimerDL*, *drx-RetransmissionTimerUL* or *drx-RetransmissionTimerSL* is running on any Serving Cell in the DRX group; or

- *ra-ContentionResolutionTimer* (as described in clause 5.1.5) or *msgB-ResponseWindow* (as described in clause 5.1.4a) is running; or

- a Scheduling Request is sent on PUCCH and is pending (as described in clause 5.4.4 or 5.22.1.5). If this Serving Cell is part of a non-terrestrial network, the Active Time is started after the Scheduling Request transmission that is performed when the *SR\_COUNTER* is 0 for all the SR configurations with pending SR(s) plus the UE-gNB RTT; or

- a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the Random Access Preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in clauses 5.1.4 and 5.1.4a).

The WID says that PDCCH skipping is only used when C-DRX is configured:

* 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]*

There are no technical reasons not to follow the WID agreement.

**Proposal-3:** RAN2 to discuss which option to select:

**Option 1**: Capture in 38.331 that PDCCH monitoring adaptation can only be configured when C-DRX is configured.

**Option 2**: No specification changes.

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A draft CR for 38.331 is provided for information.

## CR for *searchspaceGroupList* field description ([R2-2208555](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_119-e/Docs//R2-2208089.zip))

**Motivation and related change:**

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| **Issue:**  1: In the decription of *seachspaceGroupList,* the term ‘searchspaceGroupList (i.e. without suffix) is used, however, there is no such searchSpaceGroupList (i.e. without suffix) existing in the RRC ASN.1 structure, there is only searchSpaceGroupList-r16 and searchSpaceGroupList-r17. |

**The change in R2-2208555:**

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| ***searchSpaceGroupIdList-r16, searchSpaceGroupIdList-r17***  List of search space group IDs which the search space is associated with. The network configures at most 2 search space groups per BWP where the group ID is either 0 or 1 if *searchSpaceGroupIdList-r16* is included. The network configures at most 3 search space groups per BWP where the group ID is either 0, 1 or 2 if *searchSpaceGroupIdList-r17* is included. And if *searchSpaceGroupIdList-r17* is included, *searchSpaceGroupIdList-r16* is ignored. |

**Proposal 4**: Capture in 38.331 that the change present in [R2-2208555](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_119-e/Docs//R2-2208555.zip)

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| **Company** | **Yes/No** | **Comments** |
| ZTE | Yes | Proponent |
| Nokia | Yes |  |
| CATT | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Vivo | Yes |  |
| LGE | Yes |  |
| Intel | Yes |  |
| MediaTek | Yes |  |
| Qualcomm | Yes |  |
| CMCC | Yes |  |
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**Summary:** All companies agreed with the proposed corrections in [R2-2208555](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_119-e/Docs//R2-2208555.zip).

**Proposal-4:** Capture in 38.331 that the change present in [R2-2208555](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_119-e/Docs//R2-2208555.zip).

# Conclusions

*[Easy Agreements]*

**Proposal-1:** PDCCH skipping is not further clarified in 38.321.

**Proposal-2:** Wait for RAN1 outcome and postpone update of PDCCH skipping in 38.300.

**Proposal-4:** Capture in 38.331 that the change present in [R2-2208555](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_119-e/Docs//R2-2208555.zip).

*[To be discussed online]*

**Proposal-3:** RAN2 to discuss which option to select:

**Option 1**: Capture in 38.331 that PDCCH monitoring adaptation can only be configured when C-DRX is configured.

**Option 2**: No specification changes.

# References

1. [R2-2208090](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_119-e/Docs//R2-2208090.zip), *PDCCH skipping in RAN1 and RAN2 specifications*, Ericsson, DISC, RAN2#119-e
2. [R2-2208089](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_119-e/Docs//R2-2208089.zip), *PDCCH monitoring adaptation and C-DRX (RIL V146),* Ericsson, DISC, RAN2#119-e
3. [RP-220748](http://www.3gpp.org/ftp//tsg_ran/TSG_RAN/TSGR_95e/Docs//RP-220748.zip), *Revised WID UE Power Saving Enhancements for NR*, MDTK, ZTE, WID, RAN#95-e
4. [R2-2204732](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_118-e/Docs//R2-2204732.zip), *Discussion on PDCCH skipping*, OPPO, DISC, RAN2#118-e
5. [R2-2205024](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_118-e/Docs//R2-2205024.zip), *Remaining issues on PDCCH adaptation*, Nokia, DISC, RAN2#118-e
6. [R2-2206487](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_118-e/Docs//R2-2206487.zip) *Report of [AT118-e][074][ePowSav] PDCCH skipping,* Samsung, Report, RAN2#118-e
7. [R1-2204605](http://www.3gpp.org/ftp//tsg_ran/WG1_RL1/TSGR1_109-e/Docs//R1-2204605.zip), *Open issues on PDCCH monitoring adaptation for UE power saving*, Nokia, DISC, RAN1#109-e
8. [R1-2205278](http://www.3gpp.org/ftp//tsg_ran/WG1_RL1/TSGR1_109-e/Docs//R1-2205278.zip), *FL summary#2 of DCI-based power saving adaptation*, Moderator (vivo), Report, RAN1#109-e