**3GPP TSG-RAN WG1 #103-e R1-200xxxx**

**e-Meeting, October 26th – November 13th, 2020**

**Source: Moderator (Apple Inc.)**

**Title: Feature lead summary #9 on reduced PDCCH monitoring**

**Agenda item:** **8.6.2**

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

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# 1 Introduction

Contributions made under the “reduced PDCCH monitoring” agenda item of the Rel-17 study item on “Study on support of reduced capability NR devices” as well as initial evaluation results in [29] were summarized in FL summary #1 (FLS1) in R1-2008471.

This document captures the following RAN1#103e RedCap email discussion.

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| [103-e-NR-RedCap-03] Email discussion for reduced PDCCH monitoring– Hong (Apple)   * 1st check point: 10/29 * 2nd check point: 11/4 * 3rd check point: 11/10 * Last check point 11/12 |

This summary was organized based on the structure of latest TR 38.875 [1] to document the evaluation results of reduced PDCCH monitoring provided in Phase-2 post-102-e-meeting email thread [102-e-Post-NR-RedCap-01] into section 2. In addition, section 3 intends to discuss potential conclusions for this study item based on the finding in section 2.

Follow the naming convention in this example:

* RedCapPDCCHFLS2-v000.docx
* RedCapPDCCHFLS2-v001-CompanyA.docx
* RedCapPDCCHFLS2-v002-CompanyA-CompanyB.docx
* RedCapPDCCHFLS2-v003-CompanyB-CompanyC.docx

This version of document contains updated proposal tagged FL9.

# 8.2 Reduced PDCCH monitoring

## 8.2.1 Description of feature

**[FL9]**Updated **Proposal 8.2.1-1: Capture the following feature description for Scheme #2 in the TR:**

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| **Scheme #2: Extending the PDCCH monitoring gap to X slots (X>1) in connected mode**  In Rel-15/16 NR, the range of PDCCH monitoring periodicity is configurable, which is in a range of a few symbol (s) to 2560 slots subject to UE capability. Scheme#2 is to extend the minimum separation between two consecutive slots with configured PDCCH candidates to be X slots, where X . |

**If not, what modification is needed?**

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| **Company** | **Y/N** | **Comments** |
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**[FL9] Proposal 8.2.1-2: Can the following sentence commented by one company in GTW session be added into Scheme #2?**

* **Using ‘M’ to denote Rel-15 BD limit per slot and ‘N’ to denote maximum number of BDs per X slot with Scheme #2, N<M\*X to achieve average BD reduction across X slots**

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| **Company** | **Y/N** | **Comments** |
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### 8.2.3.2 Latency and Scheduling flexibility

**[FL9] Proposal 8.2.3.2-1: Which of the listed Option1 and Option can be captured into TR 38.875 for section 8.2.3 for scheduling flexibility impacts:**

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| **Option 1:** Scheduling flexibility impact by BD reduction depends on multiple factors at least including BW, Subcarrier Spacing (SCS), CORESET size, AL distribution, channel condition, number of Als per UE, number of UEs that need to be simultaneously scheduled.  **Option 2:** Reduction of BDs reduces scheduling flexibility when scheduling multiple UEs. The ~~Scheduling~~ impact ~~by BD reduction~~ depends on multiple factors at least including BW, Subcarrier Spacing (SCS), CORESET size, AL distribution, channel condition, number of Als per UE, number of UEs that need to be simultaneously scheduled. |

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| **Company** | **Comments** |
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**[FL9] Proposal 8.2.3.2-2: Capturing the following into TR 38.875 for latency impact:**

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| The latency impact due to BD reduction may largely depend on PDCCH blocking rate performance impact. If the PDCCH blocking rate is increased by BD reduction, the latency performance is expected to be increased; Otherwise, BD reduction has no impact on the latency. |

* **FL strongly stresses that please note that this is the last round of email discussion. Without consensus on this section may cause the incompletion of this study item.**

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| **Company** | **Y/N** | **Comments** |
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## 8.2.5 Analysis of specification impacts

**[FL9]** **Proposal 8.2.5-1: Capturing the following into TR 38.875 for section 8.2.5**

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| * Depending on the considered techniques, for scheme with reducing maximum number of PDCCH candidates, specification impact may include reducing the limit on maximum number of PDCCH candidates, reducing the DCI size budget, modification to DCI size alignment rule and DCI format design, to minimize the PDCCH blocking rate impact. * For Extending the PDCCH monitoring gap to X slots (X), the minimum separation between two consecutive PDCCH monitoring occasion is increased from 1 slot to X>1 slots and X needs to be specified. * For dynamic adaptation of PDCCH BD parameters in connected mode, specification impacts may include mechanisms used to dynamically adapt PDCCH BD parameters e.g., maximum number of BDs per PDCCH monitoring occasion and minimum time separation between two consecutive PDCCH monitoring occasions. * Additional specification impacts may include reducing DCI size budget, DCI format design for multiple PDSCHs scheduling, modification to PDCCH candidates dropping rule, to minimize the PDCCH blocking rate impact and avoid network restriction. |

**If not, what modification is needed to add it into TR?**

* **FL strongly stresses that please note that this is the last round of email discussion. Without consensus on this section may cause the incompletion of this study item.**

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| **Company** | **Y/N** | **Comments** |
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# 12. Conclusion

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| The PDCCH monitoring reduction for RedCap UEs has been studied. The study includes the evaluation of power saving benefit, system performance impacts, coexistence impacts, potential schemes and the corresponding specification impacts.  The power saving benefit by PDCCH monitoring reduction for RedCap UEs has been evaluated based on the agreed power model and traffic model, with the results and observations captured in section 8.2.2.  The system performance impact has been evaluated using PDCCH blocking rate as the metric, with the results and observations captured in section 8.2.3. In addition, scheduling flexibility and latency impacts have also been studied in Section 8.2.3.  Three candidate schemes for PDCCH monitoring reduction have been identified and studied with the corresponding coexistence and specification impacts captured in sections 8.2.4 and section 8.2.5, respectively.  Based on the study, it is recommended by RAN1 to specify PDCCH monitoring reduction scheme(s) with minimized PDCCH blocking rate in Rel-17 to avoid the network scheduling impact. |

**[FL9] Q 12-1: Which of the paragraphs above can be captured into TR 38.875 clause 12 for conclusion?**

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| **Company** | **Comments** |
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