3GPP TSG-RAN WG2 Meeting #118 electronic R2-220xxxx

Online, May 9-20, 2022

Agenda Item: 6.9.3.1

Source: MediaTek Inc.

**Title: [DRAFT] Report of [AT118-e][072][ePowSav] PEI and Subgrouping (Mediatek)**

Document for: Discussion and decision

# Introduction

The document summarizes the following offline discussion:

* [AT118-e][072][ePowSav] PEI and Subgrouping (Mediatek)

 Scope: Address remaining issues, not already addressed by CR rapporteurs, from tdocs under 6.9.3.1. Identify agreements, discussion points, agreeable TPs/draft CRs when applicable etc.

 Intended outcome: Report

 Deadline: for CB W2 Tuesday

Contact information

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# Discussion

## PEI monitoring

Last used cell

In RAN2#117-e, we agreed that whether UE monitors PEI only in last used cell is controlled by *lastUsedCellOnly*.

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| * A PEI-capable UE stores its “last used cell” information. FFS on how to capture this in the specifications.
* Do not introduce an associated timer for the “last used cell” information stored by UE.
* The “lastUsedCellOnly” indication is a cell-level configuration and there is no per-subgroup indication.
* Introduce a one-bit indication of *lastUsedCellOnly* in *PEI-Config*.
* RAN2 clarifies the meaning of “last used cell only”: When a cell broadcasts “last used cell only”, a UE monitors PEI only if its last connection was released by this cell.
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Controbution [1][4] addressed the issue of ‘last used cell’ determination when SDT procedure is initiated in RRC\_INACTIVE. It is proposed that if *lastUsedCellOnly* is configured in system information of a cell, the UE monitors PEI in this cell if the UE most recently “received *RRCRelease* message” in this cell (which may not be the cell where UE enters RRC\_INACTIVE).

**Q1: Do you support the proposal in [1] and corresponding changes in [4]?**

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| Company | Yes/No | Comments |
| Samsung | Yes | According to current TS 38.304, “If lastUsedCellOnly is configured in system information of a cell: The UE monitors PEI only in the cell if the **UE most recently entered RRC\_IDLE or RRC\_INACTIVE states in this cell**.In case SDT procedure is initiated in a cell (say cell 2) different from the cell (say cell 1) where UE entered RRC\_INACTIVE from RRC\_CONNECTED:* If SDT procedure fails, UE enters RRC\_IDLE. In this case UE monitors PEI in the Cell 2 if lastUsedCellOnly is configured in system information of Cell 2, as the condition “UE most recently entered RRC\_IDLE in this cell” is satisfied.
* However, since SDT procedure was unsuccessful, network does not really know that cell 2 is the last cell of UE. From network point of view last cell is still cell 1.
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Inconsistency of ‘last used cell’ between UE and network

In RAN2#117, we sent an LS to RAN3 (Cc SA2, CT1) [11] on potential mismatched understanding about the ‘last used cell’ between UE and NW still exists in NR. SA2 responded with [12], stating the following.

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| SA2 has previously agreed the following text captured in TS 23.501 (since v17.3.0) for paging strategy, PEI and UE subgrouping:“The AMF, when determining its paging strategy (see clause 5.4.3), should take into consideration whether a gNB is using Paging subgrouping based on the UE's temporary ID.NOTE: Paging messages sent to that gNB can increase UE power consumption for other UEs that support Paging Subgrouping based on the UE's temporary ID.”RAN2 and RAN3 can decide about PEI and UE Subgrouping support in the last cell, however SA2 does not expect to discuss or introduce any further Core Network changes for it.  |

Contributions [8] addressed the issue about the mismatched ‘last used cell’ between UE and NW. It was suggested that RAN2 assumes the issue is not essential in NR, and thus there is no need to introduce additional approach in NR. While RAN2 is waiting for RAN3 response, we’d like to know companies’ views on this.

**Q2: Do you agree that mismatched issue about the ‘last used cell’ between UE and NW is not essential in NR, and thus there is no need to introduce additional approach?**

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| Company | Yes/No | Comments |
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Multi-beam scenario

PEI monitoring in multi-beam scenario was addressed in [3][4][8]. These contributions proposed that in multi-beam operations, the UE assumes that the same PEI is repeated in all transmitted beams and thus the selection of the beam(s) for the reception of the PEI is up to UE implementation.

**Q3: Do you agree that in multi-beam operations, the UE assumes that the same PEI is repeated in all transmitted beams and thus the selection of the beam(s) for the reception of the PEI is up to UE implementation.**

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| Company | Yes/No | Comments |
| Samsung | Yes | As the network is not aware of exact beam location of UE’s for which the PEI is intended, network has to broadcast PEI in all the beam directions (i.e. transmitted in coverage of each transmitted SSBs). The information transmitted in PDCCH monitoring occasions of PEI occasion has to be same.On the other hand, since UE can know the suitable SSB before monitoring PEI occasion by measuring transmitted SSBs, in an implementation UE may decide to monitor only the PDCCH monitoring occasion corresponding to the suitable SSB. To enable this mapping of SSBs to PDCCH monitoring occasions in PEI occasion is defined. Similar principle is already applied for monitoring SI in SI window, monitoring paging in PO. |
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PEI indication in RRC\_INACTIVE

Contribution [6] addressed the issue about PEI indication determination in RRC INACTIVE. It was observed that if a UE in RRC INACTVIE follows the PEI indication bit derived from T used in RRC INACITVE, there may be misunderstanding for PEI indication bit between UE and network, which would lead to CN paging failure or unnecessary UE power consumption. Then it was proposed that for PEI indication bit determination, UE in RRC INACTIVE uses the same iPO as that in RRC IDLE.

**Q4: Do you agree that for PEI indication bit determination, UE in RRC INACTIVE uses the same iPO as that in RRC IDLE?**

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| Company | Yes/No | Comments |
| Samsung | Yes |  |
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## UE Subgrouping

PEI without subgrouping

In RAN2#117-e, we made the following agreements about UE subgrouping.

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| * A PEI-capable UE must support at least UEID-based subgrouping method.
* RAN2 confirms that “PEI without subgrouping” can be implemented by configuring PEI plus UEID subgrouping with one subgroup.
* “PEI without subgrouping” can be configured by only one method.
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Contributions [5][7][10] addressed the issue of “PEI without subgrouping” (RIL-O356, O357, X107). They pointed out that there is RAN1-RAN2 misalignment since according to RAN1 spec, *subgroupconfig* can be absent which means NW does not support subgrouping. Contributions [5][7] suggested that we modify RAN2 specifications to allow *subgroupconfig* to be absent. In contrast, contribution [10] suggest that 38.213 is updated such that *subgroupsNumPerPO* is always present when PEI is configured.

Then there are two options:

* Option 1: Revert RAN2 agreement to allow *subgroupConfig* to be absent.
* Option 2: Keep RAN2 agreement and request RAN1 to revise their specifications. An LS may be considered.

**Q5: How to deal with the RAN1-RAN2 mismatch about PEI without subgrouping?**

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| Company | Option | Comments |
| Samsung |  | No strong view |
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Contribution [10] also proposed that RAN2 clarify that *subgroupsNumPerPO* is > 1, when *subgroupsNumForUEID* is absent.

**Q6: Should RAN2 clarify that *subgroupsNumPerPO* is > 1, when *subgroupsNumForUEID* is absent?**

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Certain gNB(s) within an RNA does not support CN-assigned subgrouping

In RAN2 LS, we also asked RAN3 about the problematic scenario where certain gNB(s) within an RNA does not support CN-assigned subgrouping while others do. In [8], it was suggested that the problem can be avoid by CN.

**Q7: Do you agree that the problematic scenario of paging subgrouping capability within an RNA can be avoided by CN, and there is no need for any further signalling?**

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| Company | Yes/No | Comments |
| Samsung | Yes |  |
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## Interaction with RedCap feature

In Release 17, redcap specific initial DL BWP can be configured. If SIB1 includes *initialDownlinkBWP-RedCap-r17* IE and *pagingSearchSpace* is configured in this initial DL BWP for redcap UE, UE monitors PO(s) for paging in initial DL BWP indicated by *initialDownlinkBWP-RedCap-r17*.In [2] (RIL-S1000), it was proposed that *pei-SearchSpace-r17* and *firstPDCCH-MonitoringOccasionOfPEI-O-r17* needs to be configured separately for *initialDownlinkBWP-RedCap-r17* and *initialDownlinkBWP*.

**Q8: Do you agree that PEI monitoring should be handle in a different way for RedCap UE? If yes, please provide your views about the proposals in [2].**

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| Company | Yes/No | Comments |
| Samsung | Yes | **The issue is not about a new design for PEI monitoring for redcap UE.****The issue is only about the PDCCH monitoring related configuration for PEI monitoring in Redcap specific initial downlink BWP. In our view, the PEI monitoring procedure is same for both redcap UE and non redcap UE.** **The proposal in [2] is about configuration of *pei-SearchSpace-r17* and *firstPDCCH-MonitoringOccasionOfPEI-O-r17***1. Paging is supported on *initialDownlinkBWP-RedCap-r17*.
	1. Redcap UE monitors paging in *initialDownlinkBWP-RedCap-r17* if *pagingSearchSpace* is configured in *initialDownlinkBWP-RedCap-*r17. *pagingSearchSpace* can be configured in *initialDownlinkBWP-RedCap-*r17 if CD-SSB is located in Redcap Specific Initial Downlink BWP.
	2. In order to support paging in *initialDownlinkBWP-RedCap-r17,* parameter *pagingSearchSpace* is signalled ininitialDownlinkBWP-RedCap-r17 🡪 BWP-DownlinkCommon 🡪PDCCH-ConfigCommon
2. List of common search space configurations are signalled per BWP (BWP-DownlinkCommon 🡪PDCCH-ConfigCommon).
	1. Amongst this list, which search space configuration is to be used for which purpose is indicated by respective parameters (pagingSearchSpace, rarSearchSpace, OSISearchSpace, etc. each of which indicate the ID of the search space configuration to be used).

pagingSearchSpace, rarSearchSpace, OSISearchSpace are configured per BWP (not per cell) as List of common search space configurations is configured per BWP.1. In case *initialDownlinkBWP-RedCap-r17 and initialDownlinkBWP* both are configured in a cell, each have their own list of common search space configurations.
	1. For PEI monitoring in *initialDownlinkBWP-RedCap-r17, pei-SearchSpace* should indicate one of the search space configuration configured inPDCCH-ConfigCommon of *initialDownlinkBWP-RedCap-r17.*

For PEI monitoring in *initialDownlinkBWP, pei-SearchSpace* should indicate one of the search space configuration configured inPDCCH-ConfigCommon of *initialDownlinkBWP.*Since both *initialDownlinkBWP-RedCap-r17* and *initialDownlinkBWP* can be configured in a cell, *pei-SearchSpace* parameter is needed separately for *initialDownlinkBWP-RedCap-r17* and *initialDownlinkBWP,* each pointing to search space configuration of respective BWP*.*Note that both zero and non zero search space are supported for *pei-SearchSpace*.* 1. Similarly, *firstPDCCH-MonitoringOccasionOfPEI-O-r17* needs to be configured separately for *initialDownlinkBWP-RedCap-r17* and *initialDownlinkBWP*.

This parameter depends on SCS of BWP and location of PDCCH monitoring occasions in the BWP. Some same value of *firstPDCCH-MonitoringOccasionOfPEI-O-r17* may not work for both *initialDownlinkBWP-RedCap-r17* and *initialDownlinkBWP*.Also note that for similar reason firstPDCCH-MonitoringOccasionOfPO was defined per BWP and not per cell.In our view, proposed change in [2] is a simple change align with legacy principle where PDCCH monitoring related configurations (search space, firstPDCCH-MonitoringOccasionOfPO, etc.) are per BWP.  |
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## PEI-RNTI

RAN1 agreed to introduce PEI-RNTI as a fixed value, and value design is up to RAN2. In [9], it was proposed to define PEI-RNTI as 0xFFFC in MAC specifications.

**Q9: Do you agree with the CR [9]?**

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| Company | Yes/No | Comments |
| Samsung | Yes |  |
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## Other issues

**Q10: Do you see any other issues for PEI and subgrouping to be discussed?**

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| Company | Comments |
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# Conclusion

It is proposed to discuss and decide on the following proposals:

# Reference

1. R2-2204536 PEI Monitoring in last cell Samsung Electronics Co., Ltd discussion Rel-17 NR\_UE\_pow\_sav\_enh-Core
2. R2-2204537 [S1000] PEI Monitoring in Redcap Specific BWP Samsung Electronics Co., Ltd discussion Rel-17 NR\_UE\_pow\_sav\_enh-Core
3. R2-2204538 Selective Monitoring of PDCCH monitoring occasions of PEI Samsung Electronics Co., Ltd discussion Rel-17 NR\_UE\_pow\_sav\_enh-Core
4. R2-2204539 Corrections for PEI Monitoring Samsung Electronics Co., Ltd draftCR Rel-17 38.304 17.0.0 NR\_UE\_pow\_sav\_enh-Core
5. R2-2204722 [O356] correction on signalling for indication of not supporting subgrouping OPPO draftCR Rel-17 38.331 17.0.0 F NR\_UE\_pow\_sav\_enh-Core
6. R2-2204730 Discussion on PEI indication determination in RRC INACTIVE OPPO discussion Rel-17 NR\_UE\_pow\_sav\_enh-Core
7. R2-2204786 [X107][O357]Discussing on the misalignment of RAN1\_RAN2 on PEI without subgrouping Xiaomi Communications discussion
8. R2-2204805 Discussion on remaining issues on paging subgrouping and PEI vivo discussion Rel-17 NR\_UE\_pow\_sav\_enh-Core
9. R2-2205212 Introduction of PEI-RNTI MediaTek Inc., Huawei CR Rel-17 38.321 17.0.0 1262 - F NR\_UE\_pow\_sav\_enh-Core
10. R2-2206044 PEI and subgrouping Ericsson discussion Rel-17 NR\_UE\_pow\_sav\_enh-Core
11. R2-2204240 LS out on PEI and UE Subgrouping To: RAN3 Cc: SA2, CT1
12. R2-2204522 Reply LS out on PEI and UE Subgrouping (S2-2203252; contact: Qualcomm) SA2 LS in Rel-17 NR\_UE\_pow\_sav\_enh-Core To: RAN2, RAN3 Cc: CT1