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

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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.
 |

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.
 |
| Xiaomi | Yes | Agree the intention of [1] that the UE monitors PEI in this cell if the UE most recently “received *RRCRelease* message” in this cell. But more details need to be considered.Received RRCRelease message does not mean CN is always updated during the context release. RAN3 is dicussing the mismatching cases and considering whether gNB can set noLastCellUpdate in the RRCRelease message as in LTE. |
| ZTE | Yes | We think the issue is valid. And the changes in [4] can be taken into account in combination with the ‘last used cell’ issue in RAN2 LS. |

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| --- | --- | --- |
| Nokia | Yes |  |
| MediaTek | Yes | The RAN2 agreement “…a UE monitors PEI only if its last connection was released by this cell” aligns with the proposed change. We can support the change if current text in the spec causes ‘last used cell’ ambiguity in the ‘SDT failure’ case described in [4]. |
| Apple | Yes |  |
| vivo | Yes with comments | Agree the mismatch issue of “entering RRC\_IDLE” between UE and NW in the current TS 38.304.However, the proposal in [1] “*Proposal 1: 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.*” may not fully resolve the mismatched cases. E.g., the network sends RRCRelease message, but UE may locally release but cannot receive the RRCRelease message.Thus, we prefer to use the same description in TS38.331 as below:

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| --- |
| ***lastUsedCellOnly***When present, the field indicates that the UE monitors PEI only if its last connection was released by this cell. A PEI-capable UE stores its last used cell information. |

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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 |
| Xiaomi  | No | It is a valid issue. As explained in Q2, we can wait for RAN3’s input. |
| ZTE | No | We have sent to LS to RAN3, and RAN3 have got a conclusion that the issue does exist. |
| Nokia | - | Can be left to RAN3 since we sent LS last meeting. |
| MediaTek | Wait for RAN3 | This is under discussion in RAN3 and whether the problem exist in NR should be discussed there. If the answer is yes, we reuse LTE *noLastCellUpdate* mechanism to handle the case. |
| Apple | Wait for RAN3 to respond |  |
| vivo | Yes | In NR, CN is not involved for tracking the “last used cell”, which is different from LTE, i.e. the mismatch issue does not exist between UE and CN. |

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.**

|  |  |  |
| --- | --- | --- |
| 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. |
| Xiaomi | Yes? | But should this be discussed in RAN1? |
| ZTE | Yes | Yes, like paging reception |
| Nokia | Yes |  |
| MediaTek | Yes | There is no beam specific field in PEI DCI (DCI format 2\_7) in TS 38.212, and we are supportive of the proposal. |
| Apple | Yes | Agree with MediaTek.  |
| vivo | Yes | It is similar as paging reception in multi-beam operation. |

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 |  |
| Xiaomi | Yes | We agree the intention.But we have captured this in 38.300:The RRC state (RRC\_IDLE or RRC\_INACTIVE state) doesn’t impact UE subgroup of a UE |
| ZTE | No | If UE in inactive state using the T value of idle state, it is confused why the T value for inactive state is configured to UE |
| Nokia | Yes |  |
| MediaTek | Yes | Agree the following statement in [6] and support the proposal:“This issue is similar to the PO misalignment for RRC INACTVIE and RRC IDLE. Therefore, a similar solution can be used to solve the problem, that is, UE in RRC INACTIVE uses the same as that in RRC IDLE.” |
| Apple | Yes |  |
| vivo | Yes, but may be no spec impact | This issue was discussed in RAN2#115e by R2-2109077\_Report of [AT115-e][026][NR16] SI and Paging (ZTE)-Phase 1. It was agreed that

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| **Solution 2 (i.e. UE in RRC \_INACTIVE should use the same i\_s to determine PO as for RRC \_IDLE) is supported to address the RAN and CN paging PO non-overlap problem.****UE capability should be introduced to indicate support for using the same i\_s in PO determination in RRC \_INACTIVE state as in RRC \_IDLE state.** |

In our understanding, UE in RRC INACTIVE uses the same C:\Users\cmcc\AppData\Roaming\Foxmail7\Temp-16776-20211118202754\Attach\image039(11-18-20-31-35).png as that in RRC IDLE. The PEI indication bit determination naturally follows the same rule, and there is no additional spec impact. |

## 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.
 |

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 |
| Xiaomi | Option2 | We prefer to keep RAN2 agreement that without subgrouping is implemented by one subgroup. Otherwise we need to modify 38.304 which currently describes based on subgrouping.  |
| ZTE | Option 2 | It seems RAN1 have discussed it already, and suggest RAN2 not to discuss it in parallel, and hence no LS is needed. |
| Nokia | 2 | Already treated online with the following agreement:* P2: R2 assumes that 38.213 is updated e.g. such that *subgroupsNumPerPO* is always present when PEI is configured (i.e. no need to update R2 TS)
 |
| MediaTek | Option 2 | RAN1 had that ambiguous description because they were not sure how configurations would be provided by RAN2 then. Now that RAN2 has clear agreement that “PEI without subgrouping” can only be implemented by configuring PEI plus UEID subgrouping with one subgroup, we should keep RAN2 agreement and let RAN1 modify their specifications.From RAN1 email discussion on PEI maintenance (Ref: intermediate summary [**R1-2205394**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/R1-2205394.zip)), RAN1 has been discussing TP (Proposal 2.1-1) to align with RAN2 agreement. In this regard, we don’t even need to send a LS to RAN1. |
| Apple | Option 2 | We also prefer RAN2 to retain the agreement that without subgrouping is treated as one implicit subgroup.  |
| vivo | Option 2 | RAN1 is discussing this in this meeting. Thus, we should wait for RAN1’s progress. |

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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| --- | --- | --- |
| Company | Option | Comments |
| Xiaomi | No | *subgroupsNumPerPO* is = 1, when *subgroupsNumForUEID* is absent means the NW supporting only one CN-assigned subgroup which is also a valid case. |
| ZTE | No | No clarification is needed, in this scenario, only UE support CN assigned subgrouping can use PEI with subgrouping. |
| Nokia | No | Already discussed online and concluded nothing is needed. It was agreed before to support only one subgroup for CN assignment only, which is no difference from other cases of have only CN assignment without any subgroups for UE-ID based. |
| MediaTek | No need | The action for the clarification is Proposal 2 in [10]:“Proposal 2: 38.213 is updated such that *subgroupsNumPerPO* is always present when PEI is configured.”From RAN1 email discussion on PEI maintenance (Ref: intermediate summary [**R1-2205394**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/R1-2205394.zip)), RAN1 has been discussing TPs for TS 38.213 and TS 38.212 (Proposal 2.1-1) to align with RAN2 understanding, and thus additional clarification in RAN2 looks not needed. |
| Apple | No | Similar view as Xiaomi |
| vivo | No | It is un to NW configuration. It means only CN assigned subgrouping is supported.  |

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 |  |
| Xiaomi | Yes | RAN3 is the better place to discuss this. No need to discuss in RAN2. |
| ZTE | Yes | This issue have been discussed in RAN3.. |
| Nokia | - | Can be left to RAN3 since we have sent LS last meeting. |
| MediaTek | Yes |  |
| Apple | Yes |  |
| vivo | Yes |  |

## 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].**

|  |  |  |
| --- | --- | --- |
| 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.  |
| Xiaomi | No | As commented online in Week1, it is better not to discuss this now in RAN2. Redcap specific initial DL BWP is not used for paging monitoring and if companies really want to discuss this, we can wait for Redcap WI. |
| ZTE | Postpone | The spirit of this question is whether the pagingSearchSpace for REDCAP UE is the same with legacy UE. This issue is still under discussion in REDCAP session. We propose to postpone this issue until we have a clear conclusion from REDCAP session. |
| Nokia | No |  |
| MediaTek | Yes (only move pei-SearchSpace) | In current specification, pagingSearchSpace for REDCAP UEs can be different from that for eMBB UEs. If pei-SearchSpace is **not** in the same BWP with pagingSearchSpace for REDCAP UEs, it is possible **UE may need RF retuning between PEI reception and PO reception**, which causes additional power consumption for REDCAP UEs. In this regard, we support to move pei-SearchSpace to the same BWP(s) and pagingSearchSpace.On the other hand, since “firstPDCCH-MonitoringOccasionOfPO” for paging is **not** BWP specific, we should also keep current location of “firstPDCCH-MonitoringOccasionOfPEI-O-r17” for consistency and therefore are **not supportive** of the respective change. |
| Apple | No | We wait for discussion within RedCap WI before making any change |
| vivo | Yes with comments | We have some sympathy with proponent, considering paging configuration, e.g. search space, could be also configured in separate initial BWP with CD-SSB. It is reasonable to configure PEI related configuration on separate initial BWP with CD-SSB. As this issue is still being discussed in RedCap session, we could comeback this later after we agree on the design for RedCap.  |

## 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 |  |
| Xiaomi | Yes |  |
| ZTE | Yes |  |
| Nokia | Yes |  |
| MediaTek | Yes |  |
| Apple | Yes |  |
| vivo | Yes |  |

## 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