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 [Post118-e][072][ePowSav] PEI and Subgrouping (MediaTek)**

Document for: Discussion and decision

# Introduction

The document summarizes the following offline discussion:

* [Post118-e][072][ePowSav] PEI and Subgrouping (Mediatek)

 Scope: Address Last Cell issues determine TS changes, determine TS changes needed to support PEI + RedCap.

 Intended outcome: Report with TP.

 Deadline: Extra Short.

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# Discussion

## PEI monitoring in last used cell

In RAN3 reply-LS [1], it is confirmed that the mismatched understanding about the ‘last used cell’ between UE and NW also exists in NR.

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| **Question 1: Whether the mismatched understanding about the ‘last used cell’ between UE and NW still exists in NR, if so, whether the LTE method (i.e. to introduce ‘no last cell update’ indication in *RRCRelease* Message) can be reused?****RAN3's answer:** RAN3 thinks that the mismatched understanding about the ‘last used cell’ between UE and NW also exists in NR. From RAN3 perspective, the mentioned LTE method can be reused for NR, however, the final decision is up to RAN2. |

Rapporteur suggests that we take an approach similar to that in LTE, i.e., introduce *noLastCellUpdate* in RRCRelease for NR. Then if *lastUsedCellOnly* is configured in SIB1, UE monitors PEI in the cell only if it receives latest *RRCRelease* message without *noLastCellUpdate* from this cell. We have the following draft proposal.

**Proposal 1: Introduce *noLastCellUpdate* indication in *RRCRelease* to handle mismatched understanding about ‘last used cell’ between UE and NW in NR. (TS 38.331 changes needed)**

**Proposal 2: If *lastUsedCellOnly* is configured in system information of a cell, the UE monitors PEI in the cell only if the latest received *RRCRelease* without *noLastCellUpdate* is from that cell. (TS 38.304 changes needed)**

**Q1: Do you support Proposal 1?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments, TS changes |
| MediaTek | Yes |  |
| Samsung | Yes |  |
| vivo | Yes |  |
| ZTE | Yes |  |
| CATT | Yes |  |
| Intel | Yes, but | As mentioned online, there may be implication with RAN3 for the non-anchor relocation case – whether the last used cell information is provided to the new cell and whether the new cell updates the last used cell context of the UE. Introducing this should not stop RAN3 from discussing further solutions for the non-anchor relocation case.  |
| Xiaomi | Yes |  |
| Ericsson | Yes | We also have been concerned about the SDT without relocation case, but we currently have the following understanding:* The UE considers the cell in which it received *RRCRelease* without *noLastCellUpdate* the last time, as the *lastUsedCell.*
* The NW (CN and RAN) should follow/match that understanding
* The location is at cell level, and SDT with or without context relocation does perhaps not matter that much in this context
* The anchor gNB (supporting PEI) has to store the *lastUsedCell* of the UE, and convey that in the context release to the CN.
* With this stored info in RAN, the RAN could initiate RAN paging in the *lastUsedCell* first when there is DL data. But this is all up to RAN implementation (similar as the CN paging strategy).

With the above understanding this also means that the motivation for *noLastCellUpdate* in the *RRCRelease* message is reduced, e.g. this is then only needed when the gNB is overloaded and does not update the CN with the *lastUsedCell,* but does send the *RRCRelease* message to the UE? But we agree it is perhaps save to have this option. However RAN3 has not discussed the SDT without relocation case (in much details), and has not made agreements for this. Furthermore it is not clear whether RAN3 has a clear definition of what is the *lastUsedCell* for all cases, and clearly RAN2 and RAN3 need to be synchronized on that. Furthermore it is the anchor gNB (e.g. with SDT without relocation) that has to configure the *noLastCellUpdate* in the *RRCRelease* message. So we think that a sync with RAN3 is needed, after RAN2 has made agreements on the way forward. FYI: RAN3 endorsed this CR:Rev in [R3-224003](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_116-e/Inbox/R3-224003.zip) **Endorsed** |
| Huawei, HiSilicon | Yes | We could further confirm the SDT without relocation scenario with RAN 3. |

**Q2: Do you support Proposal 2?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments, TS changes |
| MediaTek | Yes |  |
| Samsung | Yes |  |
| vivo | Yes | The TP on TS 38.304 is provided below in Section 4, which will be merged into 304 CR for ePowSav. Let’s discuss the details in offline#089.In addition to the case mentioned by proposal 2, do we need to discuss the case that “If *lastUsedCellOnly* is configured in system information of a cell, and if the latest *RRCRelease* with *noLastCellUpdate* is received from that cell”? or we could assume that “SDT without relocation on the lastUsedCell cell, i.e. the same cell” could be avoided by the network implementation?[Rapp] Thanks for the TP. We may not need to discuss this case. For SDT without relocation, assume the serving cell is A but UE is released in receiving cell B after SDT, and both cells are configured with *lastUsedCellOnly* PEI.* If the gNB tells CN the last used cell = A, UE does not monitor PEI in B, but it may monitor PEI when reselecting to A
* If a “smart” gNB tells CN the last used cell = B (even if the *RRCRelease* message is generated by A), UE can monitor PEI in B
 |
| ZTE | Yes |  |
| CATT | Yes | And we think 38.331 change is needed since the field description of *lastUsedCellOnly* must be updated accordingly. See below TP. Same view as vivo for the detailed TP discussion in offline [Post118-e][071]. |
| Intel | Yes |  |
| Xiaomi | Yes | To Rapp:For your case of “SDT without relocation”, I am afraid that “smart” gNB tells CN the last used cell = B” is not applicable currently as anchor gNB needs to get the last used cell from serving gNB and then send to AMF which would impact RAN3. As you see below, currently there is no message to inform AMF.But I think you are right, UE will not use PEI in cell B even if ***lastUsedCellOnly*** is configured in cell B, because its last release **without *noLastCellUpdate*** is not in cell B. But UE can continue to use PEI in cell A when it reselects back.So P2 is correct. |
| Ericsson | Yes | We agree with the comments from vivo, rapp and Xiaomi above. But this needs to be ACKed by RAN3. |
| Huawei, HiSilicon | Yes | The text proposals for 304 and 331 seems ok and can be taken as the basis for further discussion. However, we may need to confirm SDT without relocation scenario with RAN 3. |

## UE Subgrouping capability in RNA

Regarding the potential problematic scenario that anchor gNB does not support CN-assigned subgrouping while other gNBs in the same RNA does, RAN3 LS confirmed that this can be avoided by implementation, e.g., CN-assigned subgrouping support is uniform in a certain area.

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| **Question 2: Whether this problematic scenario can be avoided or needs to be resolved through signaling? (In this scenario, assuming that the anchor gNB does not support CN assigned subgrouping).****RAN3’s answer:** From RAN3 perspective, the problematic scenario can be avoided by implementation, e.g., CN-assigned subgrouping support is uniform in a certain area e.g., RNA or TAs. RAN3 has no solution other than to assume deployment coordination. |

Rapporteur thinks that then RAN2 can assume proper network implementation for subgrouping support in an RNA. We have the following draft Proposal.

**Proposal 3: RAN2 assumes that deployment coordination for paging subgrouping capability of gNBs within an RNA can be handled by implementation, e.g., CN-assigned subgrouping support is uniform in a certain area (TA/RNA). (No specification impact)**

**Q3: Do you support Proposal 3?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments, TS changes |
| MediaTek | Yes |  |
| Samsung | Yes |  |
| vivo | Yes |  |
| ZTE | Yes |  |
| CATT | Yes |  |
| Intel | No | It should be clear that the paging subgrouping capability of gNB within an RNA should be uniform. We also think that this should be specified in the Stage-2 specification. This issue also impacts UEID based subgrouping for CN paging when not all gNBs support subgrouping.  |
| Xiaomi | Yes |  |
| Ericsson | Yes, but | RAN2 should discuss and agree what aspects of subgrouping require a uniform deployment in the RNA from an inter-operability perspective i.e. "e.g." is not sufficient to agree upon.  |
| Huawei, HiSilicon | Yes |  |

## Paging & PEI monitoring for RedCap

In Release 17, redcap specific initial DL BWP can be configured. RedCap WI made the following agreements regarding *pagingSearchSpace* and the associated physical time/frequency domain resources.

|  |
| --- |
| 2. RedCap UE in idle/inactive mode monitors paging in the RedCap-specific initial DL BWP if RedCap-specific initial DL BWP contains CD-SSB and the RedCap-specific initial DL BWP is configured with search space for paging (i.e. pagingSearchSpace).3. If paging and OSI search space are configured in the RedCap-specific initial DL BWP which contains CD-SSB, it is up to NW configuration whether the associated physical time/frequency domain resources can be the same as or different from the ones in the legacy initial DL BWP (FFS whether we need to update the field description) |

Although RedCap WI conclusion does not mention PEI, rapporteur’s understanding is that PEI monitoring should follow paging monitoring. Therefore, *pei-SearchSpace-r17* and *firstPDCCH-MonitoringOccasionOfPEI-O-r17* needs to be configured separately for *initialDownlinkBWP-RedCap-r17* and *initialDownlinkBWP*. This implies some ASN.1 re-structing, i.e., moving pei-SearchSpace-r17, *firstPDCCH-MonitoringOccasionOfPEI-O-r17* to *PDCCH-ConfigCommon* of *initialDownlinkBWP-RedCap-r17* and *initialDownlinkBWP*. Moreover, the field descriptions may need to be updated to describe RedCap-related UE behaviour. However, rapporteur suggests that this be discussion in RedCap session. We have the following proposals:

**Proposal 4: Move *pei-SearchSpace-r17*, *firstPDCCH-MonitoringOccasionOfPEI-O-r17* to *PDCCH-ConfigCommon* of *initialDownlinkBWP-RedCap-r17* and *initialDownlinkBWP*. (TS 38.331 changes needed)**

**Proposal 5: Field description updates about PEI monitoring for RedCap UEs can be discussed in RedCap session.**

**Q4: Do you support Proposal 4?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| Samsung | Yes | -- ASN1START-- TAG-PDCCH-CONFIGCOMMON-STARTPDCCH-ConfigCommon ::= SEQUENCE { controlResourceSetZero ControlResourceSetZero OPTIONAL, -- Cond InitialBWP-Only commonControlResourceSet ControlResourceSet OPTIONAL, -- Need R searchSpaceZero SearchSpaceZero OPTIONAL, -- Cond InitialBWP-Only commonSearchSpaceList SEQUENCE (SIZE(1..4)) OF SearchSpace OPTIONAL, -- Need R searchSpaceSIB1 SearchSpaceId OPTIONAL, -- Need S searchSpaceOtherSystemInformation SearchSpaceId OPTIONAL, -- Need S pagingSearchSpace SearchSpaceId OPTIONAL, -- Need S ra-SearchSpace SearchSpaceId OPTIONAL, -- Need S ..., [[ firstPDCCH-MonitoringOccasionOfPO CHOICE { sCS15KHZoneT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..139), sCS30KHZoneT-SCS15KHZhalfT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..279), sCS60KHZoneT-SCS30KHZhalfT-SCS15KHZquarterT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..559), sCS120KHZoneT-SCS60KHZhalfT-SCS30KHZquarterT-SCS15KHZoneEighthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..1119), sCS120KHZhalfT-SCS60KHZquarterT-SCS30KHZoneEighthT-SCS15KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..2239), sCS120KHZquarterT-SCS60KHZoneEighthT-SCS30KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..4479), sCS120KHZoneEighthT-SCS60KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..8959), sCS120KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..17919) } OPTIONAL -- Cond OtherBWP ]], [[ commonSearchSpaceListExt-r16 SEQUENCE (SIZE(1..4)) OF SearchSpaceExt-r16 OPTIONAL -- Need R ]], [[ sdt-SearchSpace-r17 SearchSpace OPTIONAL, -- Need R searchSpaceMCCH-r17 SearchSpaceId OPTIONAL, -- Need R searchSpaceMTCH-r17 SearchSpaceId OPTIONAL, -- Need S pei-SearchSpace-r17 SearchSpaceIdOPTIONAL, -- Cond InitialBWP-PagingfirstPDCCH-MonitoringOccasionOfPEI-O-r17 CHOICE { sCS15KHZoneT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..139), sCS30KHZoneT-SCS15KHZhalfT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..279), sCS60KHZoneT-SCS30KHZhalfT-SCS15KHZquarterT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..559), sCS120KHZoneT-SCS60KHZhalfT-SCS30KHZquarterT-SCS15KHZoneEighthT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..1119), sCS120KHZhalfT-SCS60KHZquarterT-SCS30KHZoneEighthT-SCS15KHZoneSixteenthT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..2239), sCS120KHZquarterT-SCS60KHZoneEighthT-SCS30KHZoneSixteenthT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..4479), sCS120KHZoneEighthT-SCS60KHZoneSixteenthT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..8959), sCS120KHZoneSixteenthT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..17919) }OPTIONAL, -- Cond InitialBWP-Paging commonSearchSpaceListExt2-r17 SEQUENCE (SIZE(1..4)) OF SearchSpaceExt2-r17 OPTIONAL -- Need R ]]}-- TAG-PDCCH-CONFIGCOMMON-STOP-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *InitialBWP-Only* | If *SIB1* is broadcast the field is mandatory present in the *PDCCH-ConfigCommon* of the initial BWP (BWP#0) in *ServingCellConfigCommon*; it is absent in other BWPs and when sent in system information. If SIB1 is not broadcast and there is an SSB associated to the cell, the field is optionally present, Need M, in the *PDCCH-ConfigCommon* of the initial BWP (BWP#0) in *ServingCellConfigCommon* (still with the same setting for all UEs). In other cases, the field is absent. |
| *OtherBWP* | This field is optionally present, Need R, if this BWP is not the initial DL BWP and *pagingSearchSpace* is configured in this BWP. Otherwise this field is absent. |
| *InitialBWP-Paging* | This field is mandatory present, if this BWP is the *initialDownlinkBWP* or *initialDownlinkBWP-RedCap*, and *pagingSearchSpace* is configured in this BWP and *pei-Config* is configured in *DownlinkConfigCommonSIB*. Otherwise this field is absent. |

PEI-Config-r17 ::= SEQUENCE { po-NumPerPEI-r17 ENUMERATED {po1, po2, po4, po8}, payloadSizeDCI-2-7-r17 INTEGER (1..maxDCI-2-7-Size-r17), pei-FrameOffset-r17 INTEGER (0..16),  subgroupConfig-r17 SubgroupConfig-r17, lastUsedCellOnly-r17 ENUMERATED {true} OPTIONAL, -- Need R ...} |
| vivo | Yes | Assuming some comments on the TP provided by Samsung could be discussed in RRC CR for ePowSav. |
| ZTE | Yes | It can be discussed in RRC CR for ePowerSaving |
| CATT | Yes | Taking Samsung’s TP as baseline, see below. |
| Intel | Yes |  |
| Xiaomi | Yes | Can be discussed in RRC CR for ePowerSaving. I put a comment on the “*InitialBWP-Paging*” in the TP part. |
| Ericsson | Yes | Concerning the conditional presence, we think that it should be possible to configure PEI for MBB and RedCap UEs independently.  |
| Huawei, HiSilicon | Yes | We could discuss this as part in RRC CR for ePowSav |

**Q5: Do you support Proposal 5?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| Samsung | No | Do not see any need to toss this over to redcap session. In our view, we can discuss it as part of UE PS RRC CR discussion, if any change is needed. In our view the changes are very simple and indicated below:**pei-SearchSpace**ID of dedicated search space for PEI. If the field is absent, the UE does not receive PEI in this BWP. It can be configured to one of up to 4 common SS sets configured by *commonSearchSpaceList* with *SearchSpaceId* > 0. The CCE aggregation levels and maximum number of PDCCH candidates per CCE aggregation level follows Table 10.1-1 of TS38.213 [13]. SearchSpaceId = 0 can be configured for the case of SS/PBCH block and CORESET multiplexing pattern 2 or 3.***firstPDCCH-MonitoringOccasionOfPEI-O***Offset, in number of symbols, from the start of the reference frame for PEI-O to the start of the first PDCCH monitoring occasion of PEI-O on this BWP, see TS 38.213 [13], clause 10.4A. For the case *po-NumPerPEI* is smaller than Ns, UE applies the (floor(i\_s/poNumPerPEI)+1)-th value out of (N\_s/po-NumPerPEI) configured values in *firstPDCCH-MonitoringOccasionOfPEI-O* for the symbol-level offset. When *po-NumPerPEI* is one or mutliple of Ns, UE applies the first configured value in *firstPDCCH-MonitoringOccasionOfPEI-O* for the symbol-level offset.[Rapp] We are fine to make chnages here if companies and TS rapporteur can agree to some TP. |
| vivo | See comments | Fine to discuss either in ePowSav RRC CR or in RedCap session.  |
| ZTE | Yes | Share the same view with vivo, can discuss in RRC CR of either ePowSav or RedCap |
| CATT | See comments | Also OK with Samsung’s TP. See below. We can further discuss in RRC CR offline [Post118-e][071]. |
| Intel | See comments | OK with Samsung’s TP. |
| Xiaomi | No | I guess Redcap session will not discuss this. They do not care whether we configure a PEI ss for paging ss. |
| Ericsson | No, see comments | We seem to be discussing the details already here, i.e. we think we can continue.  |
| Huawei, HiSilicon | See comments | We could discuss this as part of RRC CR discussions. |

## Other issues

**Q6: Do you see any other issues for PEI and subgrouping to be discussed?**

|  |  |
| --- | --- |
| Company | Comments |
| Ericsson | We think it would be good to send an LS to RAN3 to inform them about the RAN2 agreements, and give them the possibility to reply if there is any concern.  |
|  |  |
|  |  |

# Conclusion

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

# Text Proposals

(To be provided by TS rapporteurs)

For last used cell

-----------------------------------------------------------TP on TS 38.304 start----------------------------------------------------------------

If *lastUsedCellOnly* is configured in system information of a cell, the UE monitors PEI only in the cell if the UE most recentlyreceived *RRCRelease* without *noLastCellUpdate* in this cell. Otherwise (i.e. if *lastUsedCellOnly* is not configured in system information of a cell), the UE monitors PEI in the camped cell regardless of which cell the UE most recently entered RRC\_IDLE or RRC\_INACTIVE state.

-----------------------------------------------------------TP on TS 38.304 end----------------------------------------------------------------

For RedCap

-----------------------------------------------------------TP on TS 38.331 start----------------------------------------------------------------

– *RRCRelease*

The *RRCRelease* message is used to command the release of an RRC connection or the suspension of the RRC connection.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

***RRCRelease* message**

-- ASN1START

-- TAG-RRCRELEASE-START

RRCRelease ::= SEQUENCE {

 rrc-TransactionIdentifier RRC-TransactionIdentifier,

 criticalExtensions CHOICE {

 rrcRelease RRCRelease-IEs,

 criticalExtensionsFuture SEQUENCE {}

 }

}

RRCRelease-IEs ::= SEQUENCE {

 redirectedCarrierInfo RedirectedCarrierInfo OPTIONAL, -- Need N

 cellReselectionPriorities CellReselectionPriorities OPTIONAL, -- Need R

 suspendConfig SuspendConfig OPTIONAL, -- Need R

 deprioritisationReq SEQUENCE {

 deprioritisationType ENUMERATED {frequency, nr},

 deprioritisationTimer ENUMERATED {min5, min10, min15, min30}

 } OPTIONAL, -- Need N

 lateNonCriticalExtension OCTET STRING OPTIONAL,

 nonCriticalExtension RRCRelease-v1540-IEs OPTIONAL

}

RRCRelease-v1540-IEs ::= SEQUENCE {

 waitTime RejectWaitTime OPTIONAL, -- Need N

 nonCriticalExtension RRCRelease-v1610-IEs OPTIONAL

}

RRCRelease-v1610-IEs ::= SEQUENCE {

 voiceFallbackIndication-r16 ENUMERATED {true} OPTIONAL, -- Need N

 measIdleConfig-r16 SetupRelease {MeasIdleConfigDedicated-r16} OPTIONAL, -- Need M

 nonCriticalExtension RRCRelease-v1650-IEs OPTIONAL

}

RRCRelease-v1650-IEs ::= SEQUENCE {

 mpsPriorityIndication-r16 ENUMERATED {true} OPTIONAL, -- Cond Redirection2

 nonCriticalExtension RRCRelease-v17xy-IEs OPTIONAL

}

RRCRelease-v17xy-IEs ::= SEQUENCE {

 noLastCellUpdate-r17 ENUMERATED {true} OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

[…]

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| --- |
| ***RRCRelease-IEs* field descriptions** |
| ***cnType***Indicate that the UE is redirected to EPC or 5GC. |
| ***deprioritisationReq***Indicates whether the current frequency or RAT is to be de-prioritised. |
| ***deprioritisationTimer***Indicates the period for which either the current carrier frequency or NR is deprioritised. Value *minN* corresponds to N minutes. |
| ***measIdleConfig***Indicates measurement configuration to be stored and used by the UE while in RRC\_IDLE or RRC\_INACTIVE. |
| ***mpsPriorityIndication***Indicates the UE can set the establishment cause to mps-PriorityAccess for a new connection to a new RAT following a redirect to NR. If the target RAT is E-UTRA, see TS 36.331 [10]. The gNB sets the indication only for UEs authorized to receive MPS treatment as indicated by ARP and/or QoS characteristics at the gNB, and it is applicable only for this instance of release with redirection to carrier/RAT included in the *redirectedCarrierInfo* field in the *RRCRelease* message. |
| ***noLastCellUpdate***If *lastUsedCellOnly* is configured in *PEI-Config* of a cell, the UE monitors PEI in the cell only if the latest received *RRCRelease* without *noLastCellUpdate* is from that cell. |
| ***srs-PosRRCInactiveConfig***SRS for positioning confifuration during RRC\_INACTIVE State. |
| ***suspendConfig***Indicates configuration for the RRC\_INACTIVE state. The network does not configure *suspendConfig* when the network redirect the UE to an inter-RAT carrier frequency or if the UE is configured with a DAPS bearer. |
| ***redirectedCarrierInfo***Indicates a carrier frequency (downlink for FDD) and is used to redirect the UE to an NR or an inter-RAT carrier frequency, by means of cell selection at transition to RRC\_IDLE or RRC\_INACTIVE as specified in TS 38.304 [20]. Based on UE capability, the network may include *redirectedCarrierInfo* in *RRCRelease* message with *suspendConfig* if this message is sent in response to an *RRCResumeRequest* or an *RRCResumeRequest1* which is triggered by the NAS layer (see 5.3.1.4 in TS 24.501 [23]). |
| ***voiceFallbackIndication***Indicates the RRC release is triggered by EPS fallback for IMS voice as specified in TS 23.502 [43]. |

[…]

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| --- |
| ***lastUsedCellOnly***When present, the field indicates that the UE monitors PEI only if the latest received *RRCRelease* without *noLastCellUpdate* is from that cell. A PEI-capable UE stores its last used cell information. |

-----------------------------------------------------------TP on TS 38.331 end ----------------------------------------------------------------

For RedCap

-----------------------------------------------------------TP on TS 38.331 start----------------------------------------------------------------

***DownlinkConfigCommonSIB* information element**

-- ASN1START

-- TAG-DOWNLINKCONFIGCOMMONSIB-START

DownlinkConfigCommonSIB ::= SEQUENCE {

 frequencyInfoDL FrequencyInfoDL-SIB,

 initialDownlinkBWP BWP-DownlinkCommon,

 bcch-Config BCCH-Config,

 pcch-Config PCCH-Config,

 ...,

 [[

 pei-Config-r17 PEI-Config-r17 OPTIONAL, -- Need R

 initialDownlinkBWP-RedCap-r17 BWP-DownlinkCommon OPTIONAL -- Need R

 ]]

}

BCCH-Config ::= SEQUENCE {

 modificationPeriodCoeff ENUMERATED {n2, n4, n8, n16},

 ...

}

PCCH-Config ::= SEQUENCE {

 defaultPagingCycle PagingCycle,

 nAndPagingFrameOffset CHOICE {

 oneT NULL,

 halfT INTEGER (0..1),

 quarterT INTEGER (0..3),

 oneEighthT INTEGER (0..7),

 oneSixteenthT INTEGER (0..15)

 },

 ns ENUMERATED {four, two, one},

 firstPDCCH-MonitoringOccasionOfPO CHOICE {

 sCS15KHZoneT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..139),

 sCS30KHZoneT-SCS15KHZhalfT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..279),

 sCS60KHZoneT-SCS30KHZhalfT-SCS15KHZquarterT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..559),

 sCS120KHZoneT-SCS60KHZhalfT-SCS30KHZquarterT-SCS15KHZoneEighthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..1119),

 sCS120KHZhalfT-SCS60KHZquarterT-SCS30KHZoneEighthT-SCS15KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..2239),

 sCS120KHZquarterT-SCS60KHZoneEighthT-SCS30KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..4479),

 sCS120KHZoneEighthT-SCS60KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..8959),

 sCS120KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..17919)

 } OPTIONAL, -- Need R

 ...,

 [[

 nrofPDCCH-MonitoringOccasionPerSSB-InPO-r16 INTEGER (2..4) OPTIONAL -- Cond SharedSpectrum2

 ]],

 [[

 ranPagingInIdlePO-r17 ENUMERATED {true} OPTIONAL -- Need R

 ]]

}

PEI-Config-r17 ::= SEQUENCE {

 po-NumPerPEI-r17 ENUMERATED {po1, po2, po4, po8},

 payloadSizeDCI-2-7-r17 INTEGER (1..maxDCI-2-7-Size-r17),

 pei-FrameOffset-r17 INTEGER (0..16),

 subgroupConfig-r17 SubgroupConfig-r17,

 lastUsedCellOnly-r17 ENUMERATED {true} OPTIONAL, -- Need R

 ...

}

SubgroupConfig-r17 ::= SEQUENCE {

 subgroupsNumPerPO-r17 INTEGER (1.. maxNrofPagingSubgroups-r17),

 subgroupsNumForUEID-r17 INTEGER (1.. maxNrofPagingSubgroups-r17) OPTIONAL, -- Need S

 ...

}

-- TAG-DOWNLINKCONFIGCOMMONSIB-STOP

-- ASN1STOP

[…]

|  |
| --- |
| ***PEI-Config* field descriptions** |
|  |
| ***payloadSizeDCI-2-7***Payload size of PEI DCI, i.e., DCI format 2\_7. The size is no larger than the payload size of paging DCI which has maximum of 41 bits and 43 bits for licensed and unlicensed spectrums, respectively. |
| ***pei-FrameOffset***Offset, in number of frames from the start of a first paging frame of the paging frames associated with the PEI-O to the start of a reference frame for PEI-O, see TS 38.213 [13], clause 10.4A. |
|  |
| ***po-NumPerPEI***The number of PO(s) associated with one PEI monitoring occasion. It is a factor of the total PO number in a paging cycle , i.e N x Ns, as specified in TS 38.304 [20]. The Maximum number of PF associated with one PEI monitoring occasion is up to 2. The number of PO mapping to one PEI should be multiple of Ns when *po-NumPerPEI* is larger than Ns. |

[…]

– *PDCCH-ConfigCommon*

The IE *PDCCH-ConfigCommon* is used to configure cell specific PDCCH parameters provided in SIB as well as in dedicated signalling.

***PDCCH-ConfigCommon* information element**

-- ASN1START

-- TAG-PDCCH-CONFIGCOMMON-START

PDCCH-ConfigCommon ::= SEQUENCE {

 controlResourceSetZero ControlResourceSetZero OPTIONAL, -- Cond InitialBWP-Only

 commonControlResourceSet ControlResourceSet OPTIONAL, -- Need R

 searchSpaceZero SearchSpaceZero OPTIONAL, -- Cond InitialBWP-Only

 commonSearchSpaceList SEQUENCE (SIZE(1..4)) OF SearchSpace OPTIONAL, -- Need R

 searchSpaceSIB1 SearchSpaceId OPTIONAL, -- Need S

 searchSpaceOtherSystemInformation SearchSpaceId OPTIONAL, -- Need S

 pagingSearchSpace SearchSpaceId OPTIONAL, -- Need S

 ra-SearchSpace SearchSpaceId OPTIONAL, -- Need S

 ...,

 [[

 firstPDCCH-MonitoringOccasionOfPO CHOICE {

 sCS15KHZoneT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..139),

 sCS30KHZoneT-SCS15KHZhalfT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..279),

 sCS60KHZoneT-SCS30KHZhalfT-SCS15KHZquarterT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..559),

 sCS120KHZoneT-SCS60KHZhalfT-SCS30KHZquarterT-SCS15KHZoneEighthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..1119),

 sCS120KHZhalfT-SCS60KHZquarterT-SCS30KHZoneEighthT-SCS15KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..2239),

 sCS120KHZquarterT-SCS60KHZoneEighthT-SCS30KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..4479),

 sCS120KHZoneEighthT-SCS60KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..8959),

 sCS120KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..17919)

 } OPTIONAL -- Cond OtherBWP

 ]],

 [[

 commonSearchSpaceListExt-r16 SEQUENCE (SIZE(1..4)) OF SearchSpaceExt-r16 OPTIONAL -- Need R

 ]],

 [[

 sdt-SearchSpace-r17 SearchSpace OPTIONAL, -- Need R

 searchSpaceMCCH-r17 SearchSpaceId OPTIONAL, -- Need R

 searchSpaceMTCH-r17 SearchSpaceId OPTIONAL, -- Need S

 commonSearchSpaceListExt2-r17 SEQUENCE (SIZE(1..4)) OF SearchSpaceExt2-r17 OPTIONAL -- Need R

 ]],

[[

pei-SearchSpace-r17 SearchSpaceId, OPTIONAL, -- Cond InitialBWP-Paging

 firstPDCCH-MonitoringOccasionOfPEI-O-r17 CHOICE {

 sCS15KHZoneT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..139),

 sCS30KHZoneT-SCS15KHZhalfT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..279),

 sCS60KHZoneT-SCS30KHZhalfT-SCS15KHZquarterT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..559),

 sCS120KHZoneT-SCS60KHZhalfT-SCS30KHZquarterT-SCS15KHZoneEighthT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..1119),

 sCS120KHZhalfT-SCS60KHZquarterT-SCS30KHZoneEighthT-SCS15KHZoneSixteenthT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..2239),

 sCS120KHZquarterT-SCS60KHZoneEighthT-SCS30KHZoneSixteenthT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..4479),

 sCS120KHZoneEighthT-SCS60KHZoneSixteenthT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..8959),

 sCS120KHZoneSixteenthT-r17 SEQUENCE (SIZE (1..maxPEI-perPF-r17)) OF INTEGER (0..17919)

 } OPTIONAL, -- Cond InitialBWP-Paging

]]

}

-- TAG-PDCCH-CONFIGCOMMON-STOP

-- ASN1STOP

|  |
| --- |
| ***PDCCH-ConfigCommon* field descriptions** |
| ***commonControlResourceSet***An additional common control resource set which may be configured and used for any common or UE-specific search space. If the network configures this field, it uses a *ControlResourceSetId* other than 0 for this *ControlResourceSet*. The network configures the *commonControlResourceSet* in *SIB1* so that it is contained in the bandwidth of CORESET#0. |
| ***commonSearchSpaceList, commonSearchSpaceListExt***A list of additional common search spaces. If the network configures this field, it uses the *SearchSpaceId*s other than 0. If the field is included, it replaces any previous list, i.e. all the entries of the list are replaced and each of the *SearchSpace* entries is considered to be newly created and the conditions and Need codes for setup of the entry apply. If the network includes *commonSearchSpaceListExt*, it includes the same number of entries, and listed in the same order, as in *commonSearchSpaceList*. |
| ***controlResourceSetZero***Parameters of the common CORESET#0 which can be used in any common or UE-specific search spaces. The values are interpreted like the corresponding bits in *MIB* *pdcch-ConfigSIB1*. Even though this field is only configured in the initial BWP (BWP#0) *controlResourceSetZero* can be used in search spaces configured in other DL BWP(s) than the initial DL BWP if the conditions defined in TS 38.213 [13], clause 10 are satisfied. |
| ***firstPDCCH-MonitoringOccasionOfPEI-O***Offset, in number of symbols, from the start of the reference frame for PEI-O to the start of the first PDCCH monitoring occasion of PEI-O on this BWP, see TS 38.213 [13], clause 10.4A. For the case *po-NumPerPEI* is smaller than Ns, UE applies the (floor(i\_s/poNumPerPEI)+1)-th value out of (N\_s/po-NumPerPEI) configured values in *firstPDCCH-MonitoringOccasionOfPEI-O* for the symbol-level offset. When *po-NumPerPEI* is one or multiple of Ns, UE applies the first configured value in *firstPDCCH-MonitoringOccasionOfPEI-O* for the symbol-level offset. |
| ***firstPDCCH-MonitoringOccasionOfPO***Indicates the first PDCCH monitoring occasion of each PO of the PF on this BWP, see TS 38.304 [20]. |
| ***pagingSearchSpace***ID of the Search space for paging (see TS 38.213 [13], clause 10.1). If the field is absent, the UE does not receive paging in this BWP (see TS 38.213 [13], clause 10). |
| ***pei-SearchSpace***ID of dedicated search space for PEI. If the field is absent, the UE does not receive PEI in this BWP. It can be configured to one of up to 4 common SS sets configured by *commonSearchSpaceList* with *SearchSpaceId* > 0. The CCE aggregation levels and maximum number of PDCCH candidates per CCE aggregation level follows Table 10.1-1 of TS38.213 [13]. *SearchSpaceId* = 0 can be configured for the case of SS/PBCH block and CORESET multiplexing pattern 2 or 3. |
| ***ra-SearchSpace***ID of the Search space for random access procedure (see TS 38.213 [13], clause 10.1). If the field is absent, the UE does not receive RAR in this BWP. This field is mandatory present in the DL BWP(s) if the conditions described in TS 38.321 [3], clause 5.15 are met. |
| ***sdt-SearchSpace***Common search space for CG-SDT and RA-SDT (see TS 38.213 [13]). |
| ***searchSpaceMCCH***ID of the search space for MCCH. If the field is absent, the UE does not receive MCCH in this BWP (see TS 38.213 [13], clause 10). |
| ***searchSpaceMTCH***ID of the search space for MTCH of MBS broadcast. If the field is absent, the UE applies *searchSpaceMCCH* also for MTCH, (see TS 38.213 [13], clause 10). |
| ***searchSpaceOtherSystemInformation***ID of the Search space for other system information, i.e., *SIB2* and beyond (see TS 38.213 [13], clause 10.1) If the field is absent, the UE does not receive other system information in this BWP. |
| ***searchSpaceSIB1***ID of the search space for *SIB1* message. In the initial DL BWP of the UE′s PCell, the network sets this field to 0. If the field is absent, the UE does not receive *SIB1* in this BWP. (see TS 38.213 [13], clause 10) |
| ***searchSpaceZero***Parameters of the common SearchSpace#0. The values are interpreted like the corresponding bits in *MIB* *pdcch-ConfigSIB1*. Even though this field is only configured in the initial BWP (BWP#0), *searchSpaceZero* can be used in search spaces configured in other DL BWP(s) than the initial DL BWP if the conditions described in TS 38.213 [13], clause 10, are satisfied. |

|  |  |
| --- | --- |
| **Conditional Presence** | **Explanation** |
| *InitialBWP-Only* | If *SIB1* is broadcast the field is mandatory present in the *PDCCH-ConfigCommon* of the initial BWP (BWP#0) in *ServingCellConfigCommon*; it is absent in other BWPs and when sent in system information. If SIB1 is not broadcast and there is an SSB associated to the cell, the field is optionally present, Need M, in the *PDCCH-ConfigCommon* of the initial BWP (BWP#0) in *ServingCellConfigCommon* (still with the same setting for all UEs). In other cases, the field is absent. |
| *OtherBWP* | This field is optionally present, Need R, if this BWP is not the initial DL BWP and *pagingSearchSpace* is configured in this BWP. Otherwise this field is absent. |
| *InitialBWP-Paging* | This field is mandatory present, if this BWP is the *initialDownlinkBWP* or *initialDownlinkBWP-RedCap*, and *pagingSearchSpace* is configured in this BWP and *pei-Config* is configured in *DownlinkConfigCommonSIB*. Otherwise this field is absent. |

-----------------------------------------------------------TP on TS 38.331 end ----------------------------------------------------------------

# Reference

1. R3-224004, Reply LS on PEI and UE Subgrouping, RAN3
2. RAN2#118-e Report from Break-out session on R17 NTN, REDCAP and CE, Vice Chair