**3GPP TSG RAN WG1 #107-bis-e R1-220XXXX**

**e-Meeting, January 17th – 25th, 2022**

Agenda Item: 8.7.1.1

Source: Moderator (MediaTek)

Title: Summary of Maintenance on Paging Enhancement

Document for: Discussion and Decision

# Introduction

In this feature lead summary, there will collect, discuss and decide identified issues and proposed solutions/text proposals for the maintenance on paging enhancement related specifications [2]-[5]. In particular, the following show the category of topics to be discussed in each Section:

* Section 2: Whether and how a new PEI-RNTI for DCI format 2\_7 is supported (including fixed or configurable)
* Section 3: The ranges of the offsets for PEI-O location determination:
	+ *PEI-F\_offset*
	+ *firstPDCCH-MonitoringOccasionOfPEI-O*
	+ Necessary structure change for the time offset parameters, if needed
* Section 4: Maintenance for PEI monitoring, including
	+ Potential monitoring constraint, analogous to the following

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| If a UE is provided - one or more search space sets by corresponding one or more of *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *ra-SearchSpace*, or a CSS set by *PDCCH-Config*, and - a SI-RNTI, a P-RNTI, a RA-RNTI, a MsgB-RNTI, a SFI-RNTI, an INT-RNTI, a TPC-PUSCH-RNTI, a TPC-PUCCH-RNTI, or a TPC-SRS-RNTIthen, for a RNTI from any of these RNTIs, the UE does not expect to process information from more than one DCI format with CRC scrambled with the RNTI per slot. |

* + Assumption on UE behaviour, including what is expected if UE chooses not to monitor PEI
	+ Necessary PEI monitoring related changes, if needed
* Section 5: Other issues, including proposals/changes for new functionality

As per chair’s guidance, as quoted below, any issue that has impact to other WG(s), should be prioritized. This principle will be strictly followed for the upcoming discussions and decisions.

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| * **For all Rel-17 items that are treated in RAN#107bis-e (except MIMO and positioning), all RAN1 decisions that impact other WGs should be finalized in RAN1#107bis-e.** For the remaining WIs, plan is to do so in the first week of RAN1#108-e.
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# PEI-RNTI for DCI Format 2\_7

In RAN1#107-e meeting, it is agreed that payload size of DCI format 2\_7 can be the same as paging DCI:

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| **Agreement**For PEI DCI format, defined as DCI format 2\_7,* Total number of bits for paging indication filed is *POnumPerPEI*, if  is absent or set to 0 or 1, and the number is , if  is configured.

* + For Rel-17, UE does not expect paging indication filed size is larger than the DCI payload size
* Whether and how TRS availability indication field is included is up to Agenda Item 8.7.1.2
* Support configurable DCI payload size which **should be no larger than payload size of paging DCI**
	+ Unused bits, when applicable, are regarded as reserved bits
	+ Note: A smaller payload size is beneficial for PEI detection performance
 |

In Table 1, there summarize companies’ views from [6]-[28] related to whether and how to support a new PEI RNTI:

Table 1

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| --- | --- |
| Company | Companies’ views and proposals |
| Huawei, HiSilicon | ***Proposal 5: A new RNTI, PEI-RNTI, is used to scramble the CRC of PEI-DCI for idle/inactive mode UEs. And adopt the TP 2 in TS38.213.*** |
| ZTE, Sanechips |  |
| vivo | **Proposal 5: Support a new PEI-RNTI for DCI format 2\_7 and adopt the text proposal 2 provided in Appendix 2.** |
| CATT | ***Proposal 6: A new RNTI is used to scramble the CRC of PDCCH-based PEI***. |
| TCL | **Proposal 1: Support PEI-RNTI with a fixed RNTI value for DCI format 2\_7** |
| Samsung | **Proposal 1: Support a new RNTI, e.g. PEI-RNTI, for DCI format 2\_7** |
| DOCOMO |  |
| Spreadtrum  |  |
| Qualcomm  | **Proposal 1: A dedicated PEI-RNTI is configured by network for CRC scrambling of PEI PDCCH.** |
| OPPO | ***Proposal 1: Support new PEI-RNTI for DCI format 2\_7.*** |
| Nokia | **Proposal: Introduce PEI-RNTI with fixed value.** |
| Intel  | **Proposal 1: New PEI-RNTI can be used for PEI DCI and it can be specified.**  |
| Panasonic | **Proposal 3: Define a new semi-statically configurable RNTI for Rel.17 PEI.**  |
| Apple |  |
| xiaomi |  |
| Ericsson | Proposal 1: PEI design should allow the use of reserved bits in paging DCI in one PO as paging early indication for UEs in one or more groups in other POs.Proposal 2: For the PEI DCI, the RNTI used for CRC masking is configured via higher layers. Proposal 3: If full configurability is not agreeable, it should at least be possible to configure the UE with either the P-RNTI or PEI-RNTI for PEI CRC scrambling. |
| Lenovo, Motorola Mobility | **Proposal 2: RNTI for a PEI PDCCH is determined based on the first (i.e. earliest) PF of one or multiple PFs associated with the PEI PDCCH.** |
| Transsion | ***Proposal 2: New and fixed PEI-RNTI for PEI is supported.*** |
| LG Electronics | **Proposal 2: A new RNTI value dedicated for PEI is supported. The new RNTI value is fixed and not configurable.**  |
| CMCC | **Proposal 1. Support a new PEI-RNTI with a fixed value for DCI format 2\_7 and the following TPs are suggested:****TS 38.213 section 10.1:****<**Unchanged text is omitted>- a Type2A-PDCCH CSS set configured by *peiSearchSpace* in *DownlinkConfigCommonSIB* for a DCI format 2\_7 with CRC scrambled by a PEI-RNTI on the primary cell of the MCG**<**Unchanged text is omitted>**TS 38.213 section 10.4B:****<**Unchanged text is omitted>A UE in RRC\_IDLE state or RRC\_INACTIVE state can be provided by *TRS-ResourceSetConfig* a set of TRS occasions [6, TS 38.214]. If *TRS-ResourceSetConfig* is provided, a DCI format 2\_7 with CRC scrambled by PEI-RNTI or a DCI format 1\_0 with CRC scrambled by P-RNTI includes a TRS availability indication field [4, TS 38.212] that provides a bitmap to groups of TRS resource sets where the configuration of each TRS resource set includes an association to a bit of the bitmap. **<**Unchanged text is omitted> |
| MediaTek  | Proposal 1: A new fixed PEI-RNTI is supported for DCI format 2\_7. Value of PEI-RNTI is up to RAN2 design. |
| Nordic Semiconductor ASA |  |
| InterDigital |  |

From the above views, it is observed that 16 out of 16 companies all support a new RNTI. In this regard, moderator would like to support a quick proposal, regarding the consensus:

**Proposal 2-1**:

**A new PEI-RNTI is supported for DCI format 2\_7. The following text proposals are adopted:**

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| **TS 38.213 section 10.1:****<**Unchanged text is omitted>- a Type2A-PDCCH CSS set configured by *peiSearchSpace* in *DownlinkConfigCommonSIB* for a DCI format 2\_7 with CRC scrambled by a PEI-RNTI on the primary cell of the MCG**<**Unchanged text is omitted> |
| **TS 38.213 section 10.4B:****<**Unchanged text is omitted>A UE in RRC\_IDLE state or RRC\_INACTIVE state can be provided by *TRS-ResourceSetConfig* a set of TRS occasions [6, TS 38.214]. If *TRS-ResourceSetConfig* is provided, a DCI format 2\_7 with CRC scrambled by PEI-RNTI or a DCI format 1\_0 with CRC scrambled by P-RNTI includes a TRS availability indication field [4, TS 38.212] that provides a bitmap to groups of TRS resource sets where the configuration of each TRS resource set includes an association to a bit of the bitmap. **<**Unchanged text is omitted> |

Regarding the value of the new RNTI, the following statistics show slight majority on a fixed value. Accordingly, Proposal 2-2 is suggested for further discussion, and companies are encouraged to provide comments/suggested changes to Proposals 2-1 and 2-2 in the table below.

* Fixed value (5): TCL, Nokia, Transsion, LG, MTK
* Configurable value (3): QC, Panasonic, Ericsson
* Other: Lenovo (function of 1st PF)

**Proposal 2-2**:

**PEI-RNTI is of fixed value, and value design is up to RAN2**

Table 2: Companies’ comments/suggested changes to Proposal 2-1 and Proposal 2-2

|  |  |
| --- | --- |
| Company | Companies’ comments/suggested changes |
| Nordic | 2-1 OK, 2-2 OK |
| Xiaomi | OK with Proposal 2-1 and 2-2 |
| Spreadtrum | OK for both |
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# Ranges of The Time Offsets for PEI-O Location Determination

In RAN1#107-e [4], the ranges of a frame-level offset and a symbol-level offset for PEI-O location determination remain to be specified (as quoted below), and Figure 1 illustrates how the offsets are utilized for the PEI-O location, for the case one PEI-O is mapped to POs of a PF or two PFs.

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| **Agreement*** Determination of PEI-O location for UE’s PO is based on deciding a reference point and an offset from the reference point to the start of the first PDCCH MO of the PEI-O.

o   The reference point is the start of a reference frame determined by a frame-level offset from the start of the first PF of the PF(s) associated with the PEI-O and configured via SIB for the cell.* + - **FFS: The range of the frame-level offset**

o   There is a symbol-level offset from the reference point to the start of the first PDCCH MO of PEI-O, provided by *firstPDCCH-MonitoringOccasionOfPEI-O* and configured via SIB for the cell.* + - **FFS: The range of the symbol-level offset**
* Note: When PEI-O is placed close to or overlapped with an earlier SS burst before its associated POs, the total UE wake-up time can be reduced for better power saving gain. Network can configure the PEI-O location accounting the power saving benefit and potential impact on gNB flexibility.
 |



Figure 1: Illustration of PEI-O location determination

In Table 3, there summarize companies’ views related to time offsets for PEI-O location determination:

Table 3

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| --- | --- |
| Company | Companies’ views and proposals |
| Huawei, HiSilicon | ***Proposal 1: For the values for the frame-level offset from the start of the first PF of the PF(s) associated with the PEI-O, support an integer number X of half SS burst periodicity, where X is a number in the value range of {0,1,2,3,4,5,6}.******Proposal 2: For the symbol-level offset from the reference point, determined by the start of frame-level offset, to the start of the first PDCCH monitoring occasion of PEI-O, support the values of:**** ***{0..139} for SCS 15kHz***
* ***{0..279} for SCS 30kHz***
* ***{0..559} for SCS 60kHz***
* ***{0..1119} for SCS 120kHz***
 |
| ZTE, Sanechips | Proposal 4: The range of the frame-level offset can be {0, 1, 2, 3, 4, 5, 6}.Proposal 5: The range of the symbol-level offset is suggested as 0-139 for 15 KHz SCS, 0-279 for 30KHz SCS, 0-559 for 60KHz SCS, 0-1119 for 120KHz SCS. Proposal 6: One frame-level offset and multiple symbol-level offsets are needed for the PEI-to-PO mapping when the number of the POs associated with one PEI ($N\_{PO}^{PEI}$) is smaller than the number of POs in one PF ($N\_{S}$).Proposal 7: The symbol-level offset of the PEI corresponding the ($i\_{S}$ + 1)th PO is the (floor(($i\_{S}$ + 1)/$N\_{PO}^{PEI}$)+1)th value configured by the symbol-level offset. |
| vivo | **Proposal 1: The value range of the frame-level offset (*PEI-F\_offset*) should be {4, 5, 6, 7, 8…}.****Proposal 2: The value range of the symbol-level offset (*firstPDCCH-MonitoringOccasionOfPEI-O*) can be one of the following:*** **Option 1: the value range is from 0 to the length of PEI-frame i.e., (0…10\***$2^{μ}$**\*14-1) where** $μ$ **is the subcarrier spacing (SCS) configuration.**
* **Option 2: Similar to the configuration of *firstPDCCH-MonitoringOccasionofPO* defined in TS 38.331 i.e., the value range is (0…** $\frac{10\*2^{μ}\*14}{x}$**-1), where x=1, 1/2, 1/4, 1/8, 1/16… represents the density of PEI-frame in a paging cycle and is configured by RRC.**
* **Option 3: the value range is from 0 to the length of the configured *PEI-F\_offset* i.e., (0…f\*10\***$2^{μ}$**\*14-1), where f is the value of the *PEI-F\_offset*.**

**Proposal 3: Configure the list of *firstPDCCH-MonitoringOccasionOfPEI-O* per PEI-frame or per paging cycle. Each of PEI-Os in the list corresponds to a *firstPDCCH-MonitoringOccasionOfPEI-O* parameter.** |
| CATT | ***Proposal 1: The range of frame-level offset PEI\_offset is {0, 1}.******Proposal 2: The range of symbol-level offset, i.e.*** ***firstPDCCH-MonitoringOccasionOfPEI-O, is same as the range of firstPDCCH-MonitoringOccasionOfPO.******Proposal 3: The PEI-O location could be determined by one of the following methods:**** ***Method 1: Four steps are used to determine the PEI-O location.***
	+ ***Method 1\_step 1: Calculate PF\_Index.***
		- ***PF\_Index = (floor(SFN\_PF\*N /T)) mod (Ceil(***$PONumPerPEI$***/Ns))***
			* ***PF\_Index is the index of PF within the PF(s) associated with the PEI-O***
			* ***SFN\_PF is the SFN of UE’s Paging Frame in the DRX cycle***
			* ***N is the number of total paging frames within T***
			* ***T is a DRX cycle***
			* ***Ns is the number of paging occasions for a PF***
			* $PONumPerPEI$ ***is the number of PO associated with the PEI-O***
	+ ***Method 1\_step 2: The first PF of PF(s) associated with one PEI is the PF with PF\_Index = 0.***
	+ ***Method 1\_step 3: Calculate the reference frame based on the first PF and frame-level offset.***
		- ***(SFN\_PEI + PEI\_offset) mod T = SFN\_FirstPF***
			* ***SFN\_PEI is the SFN of reference frame of PEI occasion***
			* ***PEI\_offset is a frame-level offset used in determining the reference frame of PEI occasion***
			* ***T is a DRX cycle***
			* ***SFN\_FirstPF is the SFN of first PF of the PF(s) associated with a given PEI***
	+ ***Method 1\_step 4: Calculate the index of the PEI within reference frame.***
		- ***PEI\_i\_s = (floor(UE\_ID/N)mod Ns) mod Ceil(Ns/***$PONumPerPEI$***)***
			* ***PEI\_i\_s is the index of the PEI within reference frame***
			* ***N is the number of total paging frames in T***
			* ***Ns is the number of paging occasions for a PF***
			* $PONumPerPEI$***is the number of PO associated with the PEI-O***
			* ***UE\_ID is the 5G-S-TMSI mod 1024***
* ***Method 2: Two steps are used to determine the PEI-O location.***
	+ ***Method 2\_step 1: Calculate reference frame based on the first PF and frame-level offset.***
		- ***(SFN\_PEI + PF\_offset + PEI\_offset) mod T = (T div N) \* floor((UE\_ID mod N) /A) \* A***
			* ***SFN\_PEI is the SFN of reference frame***
			* ***PF\_offset is a frame-level offset used for PF determination***
			* ***PEI\_offset is a frame-level offset used for reference frame determination***
			* ***T is a DRX cycle***
			* ***N is the number of paging frames in a DRX cycle***
			* ***Ns is the number of paging occasions in a Paging Frame***
			* $PONumPerPEI$ ***is the number of PO associated with the PEI-O***
			* ***A = Ceil(***$PONumPerPEI$***/Ns)***
			* ***UE\_ID is the 5G-S-TMSI mod 1024***
	+ ***Method 2\_step 2: Calculate the index of the PEI within the reference frame of PEI occasion.***
		- ***PEI\_i\_s = (floor(UE\_ID/N)mod Ns) mod Ceil(Ns/***$PONumPerPEI$***)***
			* ***PEI\_i\_s is the index of the PEI within the reference frame***
			* ***N is the number of total paging frames in T***
			* ***Ns is the number of paging occasions for a PF***
			* $PONumPerPEI$ ***is the number of PO associated with the PEI-O***
			* ***UE\_ID is the 5G-S-TMSI mod 1024***
 |
| TCL | ***Observation 1: A frame level offset of 2 radio frames satisfy the condition of one SSB burst with 20m sec periodicity between the reference point and the first PO of the first PF of the PF(s) associated with the PEI-O.*** ***Observation 2: A frame level offset of 6 radio frames satisfy the condition of three SSB bursts with 20m sec periodicity between the reference point and the first PO of the first PF of the PF(s) associated with the PEI-O.*** **Proposal 2: For the frame level offset between the PEI-O and the first PF of the PFs associated with PEI-O, a flexible range of frame level offset; i.e. {2, …. , 48} radio frames offset should be defined to guarantee the idle/inactive UE synchronization before paging.** **Proposal 3: Define the symbol level offset from the reference point to the start of the first PDCCH MO of PEI-O according to the firstPDCCHmonitoringOccasionOfPO as defined in TS 38.331.**  |
| Samsung | **Proposal 2: Adopt applicable value for *PEI-F\_offset* in the range of [**$O\_{min}$**, …, PagingCycle] for TS 38.331.*** $O\_{min}$ **= [3]**

**Proposal 3: Adopt applicable value for *firstPDCCH-MonitoringOccasionOfPEI-O* 0, …, 140\***$2^{μ}$**-1, where is SCS configuration of initial DL BWP.** |
| DOCOMO |  |
| Spreadtrum  | ***Proposal 4: The range of PF offset can be reused for the range for the frame-level offset for PEI occasion.******Proposal 5: The range of the symbol-level offset for PO can be reused for the range for the symbol-level offset for PEI occasion.*** |
| Qualcomm  | **Proposal 4: Range of the frame-level offset for PEI-O is {0, 1, 2}. Range of the symbol-level offset is from 0 to** $140×2^{μ}-1$ **to cover the duration of a radio frame where** $μ$ **is the numerology factor of the initial DL BWP.** |
| OPPO | ***Proposal 2: When the POs in same PF are associated with different PEI-Os, how to configure the frame-level offset and symbol-level offset need to be clear.******Proposal 3: When the POs in same PF are associated with different PEI-Os, (Ns/POnumPerPEI) frame-level offsets and symbol-level offsets could be configured.*** * ***If PEI-Os are located in the same PF, corresponding frame-level offsets have the same value, while the corresponding symbol-level offsets have the different value.***
* ***If PEI-Os are located in different PFs, corresponding frame-level offsets have different value, while corresponding symbol-level offsets could have the same or different value.***
 |
| Nokia | **Proposal: PEI frame offset (*PEI-F\_offset*)** **could be defined in radio frames, and be separate for each PEI, with range of {1,2,3,…,15,16}.****Proposal: PEI symbol level offset (*firstPDCCH-MonitoringOccasionOfPEI-O*) range could be defined to cover at least following range:*** **for 15kHz sub-carrier spacing: {0,1,2,..,139}**
* **for 30kHz sub-carrier spacing: {0,1,2,..,279}**
* **for 60kHz sub-carrier spacing: {0,1,2,..,559}**
* **for 120kHz sub-carrier spacing: {0,1,2,..,1119}**
* **for 480kHz sub-carrier spacing: {0,1,2,..,4479}**
* **for 960kHz sub-carrier spacing: {0,1,2,..,8959}**
* **FFS for additional values for N>1 cases.**
 |
| Intel  | **Proposal 4: For determination of PEI-O location,*** **Possible values of frame-level offset include 0 and 1.**
* **Unit and range of symbol level offset follow same design as *firstPDCCH-MonitoringOccasionOfPO***
 |
| Panasonic | **Observation 1: An frame-level offset with range {0, 1, 2, …, 15} is able to provide sufficiently small gap between SSB and PEI. Between PEI and paging PDCCH, there can also possibly be one or more SSB bursts for UE to use to improve paging PDSCH performance, depending on the SSB periodicity configuration.****Observation 2: Although the maximum gap between the first PFs of two PEI-Os can be 32 radio frames, it is not so necessary to support the full range offset as the allocation of PFs is already sufficiently flexible.****Proposal 1: To determine the PEI-O location, the range of the frame-level offset used to determine the start of the reference frame should be from 0 to no larger than 15. We are also open to discuss a smaller range.****Proposal 2: To determine the PEI-O location, the symbol-level offset from the reference point reuses the range of high layer parameter *firstPDCCH-MonitoringOccasionOfPO*. The exact name and structure definition of this symbol level offset can be up to RAN2.** |
| Apple |  |
| xiaomi |  |
| Ericsson | Proposal 6: PEI transmissions should not be restricted to be in conjunction/adjacent to other transmission.Proposal 7: The range of the frame-level offset (*PEI-F-offset*) is up to 8 frames.Proposal 8: The range of the symbol-level offset (*firstPDCCH-MonitoringOccasionOfPEI-O*) is up to 1119 symbols. |
| Lenovo, Motorola Mobility |  |
| Transsion | ***Proposal 3: Frame-level offset can select from the set of {0,1}.******Proposal 4: Symbol-level offset can follow the PO principle.*** |
| LG Electronics | **Proposal 1*** **The value range of the frame level offset, which is for determining a reference point of PEI, is {1, 2, 3 … 16} radio frames.**
* **The value range of the symbol level offset for PEI is same as the value range of the symbol level offset for PO.**
 |
| CMCC | **Proposal 2. The SFN for PFI is determined by:****(SFN + PF\_offset - PEI-F\_offset) mod T = (T div (N/*PFnumPerPEI*))\*((UE\_ID mod N) mod *PFnumPerPEI*)****Where *PFnumPerPEI* =1 if Ns>= *POnumPerPEI* and *PFnumPerPEI* =2 if Ns < *POnumPerPEI*.****The value range of PEI-F\_offset can be {0,1,2,3…,16}.****Proposal 3. *firstPDCCH-MonitoringOccasionOfPEI-O* comprises** $\left(PFnumPerPEI\*N\_{s}/POnumPerPEI\right)$ **entries and the same range definition as *firstPDCCH-MonitoringOccasionOfPO* is reused for each entry of *firstPDCCH-MonitoringOccasionOfPEI-O*.** |
| MediaTek  | Observation 1: Design of the *PEI-F-offset* time offset range should ensure: 1) The reference frame contains a SS burst, and 2) There is at least one SS burst between PEI-O and PO.Proposal 3: The range of the frame-level offset for PEI-O, i.e., *PEI-F\_offset*, is {3, 4, 5, 6}.Proposal 4: The range of the symbol-level offset for PEI-O, i.e., *firstPDCCH-MonitoringOccasionOfPEI-O*, has effective minimum of 1 slot, i.e., 14 symbols, and effective maximum of 2 ms, i.e., 28, 56, 112, 224 symbols for $μ=1, 2, 4, 8$, respectively. |
| Nordic Semiconductor ASA | ***Proposal-1:*** *Range of frame-level offset could be from 1 to 16 frames. Reuse firstPDCCH-MonitoringOccasionOfPO ranges for PEI.* |
| InterDigital | **Proposal 1: The range of the frame level offset is {0, 1}.** **Proposal 2: When *firstPDCCH-MonitoringOccasionOfPEI-O* is not present, the symbol-level offset is set to 0.** |
|  |  |

Although Figure 1 shows one frame-level offset and one symbol-level offset will be sufficient, multiple time offsets will be necessary for the case one PEI-O is only mapped to part of POs of a PF, as shown in the figure below quoted from [7].



Figure 2: Need of multiple time offsets for the case one PEI-O is mapped part of POs of a PF [7]

In analogy of PO location determination design where multiple POs can apply multiple symbol-level offsets from a common PF start, the method of multiple symbol-level offsets can be applied to PEI-O. Accordingly, the following proposal is suggested, and companies are encouraged to provide your comments/suggested changes to Proposal 3-1 in the table below:

**Proposal 3-1:**

**One frame-level offset and multiple symbol-level offsets are supported for the PEI-to-PO mapping when the number of the POs associated with one PEI (**$N\_{PO}^{PEI}$**) is smaller than the number of POs in one PF (**$N\_{S}$**).**

Table 4: Companies’ comments/suggested changes to Proposal 3-1

|  |  |
| --- | --- |
| Company | Companies’ comments/suggested changes |
| Nordic  | We do not support, different MO-offsets should be configured for different PEIs |
| Xiaomi | Support Proposal 3-1 in general. |
| Spreadtrum | Different PEI-O should have different starting symbol? If it is true, the proposal is reasonable. Oppositely, if the different two PEI-Os can share the same starting symbol, but FDMed in a CORESET, the proposal can be postponed. |
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For the range of the frame-level offset, i.e., *PEI-F\_offset*, the following summarize the statistics of companies’ views:

* Maximum:
	+ < 6 (5 companies): CATT (max = 1), QC (max = 2), Intel (max = 1), Transsion (max = 1), IDC (max = 1)
	+ 6 (3 companies): HW, ZTE, MTK
		- HW: Unit can be (SS burst period / 2)
	+ >6 (10 companies): vivo, TCL (max = 48), Samsung (max = paging cycle), Spreadtrum (max = paging cycle), Nokia (**max = 16),** Panasonic (**max = 15**), Ericsson (**max = 16**), CMCC (**max = 16**), Nordic (**max = 16**)
* Minimum:
	+ 0 (10 companies): HW, ZTE, CATT, spreadtrum, QC, Intel, Panasonic, Transsion, CMCC, IDC
		- HW: Need a minimum time gap between PEI and PO
	+ >0 (7 companies): vivo (min = 4), TCL (min = 2), Samsung (min = 3), Nokia (**min = 1**),
	LG (**min = 1**), MTK (min = 3), Nordic (**min = 1**)

From the above, one of the possible considerations for the maximum is to align a SS burst. Since maximum SS burst period can be 160 ms, we also see max = 15/16 has the most support. Since a larger maximum also include a smaller maximum, moderator would like to suggest companies to further check whether maximum of 16 frames can be acceptable. For the minimum value, 0 frame looks of the most support, while a time gap between PEI and PO would be necessary to define (otherwise, the time for UE preparation for PO can be “tighter” than connected-mode DCP and first slot of DRX on-duration). An alternative is to set a smallest non-zero number, i.e., 1 frame, so that to waive the need for additional PEI-PO time gap. Moderator thinks either of the two alternatives can work and would like suggest companies to further check and discuss. Companies are encouraged to provide comments/suggested changes on Proposal 3-2 in the table below.

**Proposal 3-2**:

**For the range of frame-level offset, *PEI-F\_offset*,**

* **Maximum value is 16 frames**
* **Minimum value is :**
	+ **Alt-1: 0 frame**
		- **FFS: minimum time gap between PEI and the indicated PO**
	+ **Alt 2: 1 frame**

Table 5: Companies’ comments/suggested changes to Proposal 3-2

|  |  |
| --- | --- |
| Company | Companies’ comments/suggested changes |
| Nordic | We support |
| Xiaomi | Support. And prefer Alt-1. Considering the fact that SSB periodicity can be 5ms in minimum, so it is possible that two SSBs are contained in 10ms, that is within the same frame. in this situation, even PEI and PO are located in one frame, power saving gain still exists. So 0 frame offset is possible for PEI. |
| Spreadtrum | We support the full flexibility of PEI\_F-offset, if it is up to UE whether or not to detect PEI. If UE has freedom to monitor PEI or paging DCI, the large PEI\_F-offset is not so problematic. Suggest to agree it is up to UE whether or not to detect PEI at first. However, if it is the majority view, we support Alt-1 for simplicity. |
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For the range of the symbol-level offset, *firstPDCCH-MonitoringOccasionOfPEI-O*, there is only one company (MTK) should like to suggest restriction on maximum value to 14 symbols, while all other companies think minimum value of 0 symbol. For the maximum value of the symbol-level offset, the following statistics can be identified:

* <10 ms: MTK (2 ms)
* 10 ms (6 companies): HW, ZTE, vivo, Samsung, QC, Nokia
* Same as PO, i.e., T/N (10 companies): vivo, CATT, TCL, Spreadtrum, Intel, Panasonic, Transsion, LG, CMCC, Nordic
* Other: vivo (up to span of PEI-F\_offset), Ericsson (up to 1119 symbols)

By the above, the following proposal is suggested, and companies are encouraged to provide comments/ suggested changes to Proposal 3-3 in the table below.

**Proposal 3-3**:

**For the range of symbol-level offset, *firstPDCCH-MonitoringOccasionOfPEI-O*,**

* **Minimum value is 0 symbol**
* **Maximum value:**
	+ **Alt-1: Same as ‘***firstPDCCH-MonitoringOccasionOfPO’***, i.e., symbol number corresponding to T/N as defined in TS 38.304**
	+ **Alt-2: Symbol number corresponding to 10 ms, i.e., (0…10\***$2^{μ}$**\*14-1) where** $μ$ **is the subcarrier spacing (SCS) configuration**
* **FFS, if PEI and the indicated PO can overlap in the same slot: Minimum time gap between PEI and the indicated PO**

Table 6: Companies’ comments/suggested changes to Proposal 3-3

|  |  |
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| Company | Companies’ comments/suggested changes |
| Nordic | We support |
| Xiaomi | Support the proposal. and prefer Alt-2. |
| Spreadtrum | Alt-1 |
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# Maintenance for PEI Monitoring

In Table 7, there summarize companies’ views and proposals related to maintenance for PEI monitoring:

Table 7

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| Company | Companies’ views and proposals |
| Huawei, HiSilicon | ***Proposal 3: UE is not required to monitor PDCCH PEI during the Y ms prior to the start of the target PO, which is used for UE processing of PEI before the PO.*** ***Proposal 8: Make the proposed conclusion in RAN1#107-e, which was not concluded due to the time limit:******For a UE supporting R17 paging enhancement feature, it is up to UE implementation whether the UE monitors the MO(s) for a PEI.**** ***If UE decides to not to monitor PEI, it has to monitor UE’s PO as defined in 38.304.***
 |
| ZTE, Sanechips | Proposal 1: Clarification of the determination of the first PF of the PF(s) associated with one PEI is needed.Proposal 2: The SFN of the first PF of the PFs associated with one PEI can be determined by $SFN\_{firstPF}=SFN\_{PO}-floor\left(i\_{PO}/N\_{S}\right)⋅(T/N)$, where $SFN\_{PO}$ is the SFN of the UE’s PF, $i\_{PO}$ is a PO index among the POs associated with the PEI, $N$, $N\_{S}$, and $T$ are defined in TS 38.304. |
| vivo | **Proposal 4: PEI DCI should carry the indicated PO group index to avoid the ambiguity e.g., adding 0-2bits PO group index indication in PEI DCI and adopt the text proposal 1 provided in Appendix 1.**we suggest to discuss this restriction for UE monitoring of DCI format 2\_7 after that.

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| If a UE is provided - one or more search space sets by corresponding one or more of *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *ra-SearchSpace*, or a CSS set by *PDCCH-Config*, and - a SI-RNTI, a P-RNTI, a RA-RNTI, a MsgB-RNTI, a SFI-RNTI, an INT-RNTI, a TPC-PUSCH-RNTI, a TPC-PUCCH-RNTI, or a TPC-SRS-RNTIthen, for a RNTI from any of these RNTIs, the UE does not expect to process information from more than one DCI format with CRC scrambled with the RNTI per slot. |

 |
| CATT | ***Proposal 4: If a UE is configured with an eDRX cycle longer than 1024 radio frames, PEI Time Window is defined and related to the frame-level offset of reference frame determination.******Proposal 5: ‘peiSearchSpace’ can be configured with SearchSpaceZero.*** |
| TCL | ***Observation 3: If an idle/inactive UE has decided not to monitor a PEI and monitor the UEs PO, it will unnecessarily wake up the UE for paging PDCCH monitoring even if the UE is not paged by the network.*** **Proposal 4: If an idle/inactive UE decides not to monitor PEI, the UE has not to monitor the PO and stay in sleeping mode.**  |
| Samsung |  |
| DOCOMO | In the case that the size of DCI Format 2\_7 is less than total number of bits of information informed via PEI, UE should monitors a paging occasion determined according to [17, TS 38.304]; |
| Spreadtrum  | ***Proposal 2: Re-check the equation of the relative PO index agreed in RAN1#107e. If it is problematic, consider the original equation proposed in RAN1#107e, i.e., i\_po = ((UE\_ID mod N) mod PFnumPerPEI)\*Ns + i\_s, where PFnumPerPEI = ceil(POnumPerPEI/Ns).******Proposal 3: If the spec should describe the equation of the first PF of the PF(s) associated with the PEI-O, the equation could be:******(SFN\_pei + PEI\_F\_offset) mod T = (T / N\_pei ) \* i\_pei,******where SFN\_pei is the SFN of the first PF of the PF(s) associated with the PEI-O, PEI\_F\_offset is the frame-level offset of PEI, i\_pei = floor(UE\_ID/(N/N\_pei)) mod N\_pei, and N\_pei is the number of PEI occasions in a paging cycle.*** |
| Qualcomm  | It does not preclude the configuration that one PEI is mapped to two PFs belonging to two different paging cycles. Note that one paging cycle has an even number of PFs. There seems no need to consider the case that the first PF mapped to the PEI is an odd numbered PF within the paging cycle although there seems no obvious harm to have such a configuration. It may be more convenient for network implementation to limit paging operation for all UEs within each paging cycle. There can be a similar concern for UE implementation. To keep the design simple without potential implantation issues, we propose to preclude PEI mapping across paging cycle boundary.**Proposal 2: If two PFs are associated with a PEI, the two PFs belong to the same paging cycle.****Proposal 3: Clarify whether the first PF of PFs associated with a PEI-O is based on** * **Understanding 1: PDCCH monitoring occasions of *peiSearchSpace* on the PEI occasion have a floating start (similar to paging PDCCH). Need to explicitly define the first PF associated with the PEI, e.g., every even numbered PF in the paging cycle is a first PF if two PFs are associated with a PEI-O.**
* **Understanding 2: Configuration of *peiSearchSpace* provides start of the first PEI PDCCH monitoring occasion of the PEI-O based on the offset information embedded in *monitoringSlotPeriodicityAndOffset* in IE *SearchSpace*.** **UE hypothetically (i.e., at most twice) derives the PEI-O location by either assuming its PF is the first PF or the PF prior to its PF is the first PF. The one that complies with *peiSearchSpace* configuration and the frame/symbol-level offsets is used to determine the PEI-O.**

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| --- |
| **Proposed conclusion:**For a UE supporting R17 paging enhancement feature, it is RAN1 understanding that it is up to UE implementation whether the UE monitors the MO(s) for a PEI (No RAN1 spec impact)* If UE decides to not to monitor PEI, it has to monitor UE’s PO as defined in 38.304 (No RAN1 spec impact)
 |

**Proposal 5: RAN1 agrees on the following proposed conclusion that has been thoroughly discussed during RAN1 #107-e email discussions.*** **Proposed conclusion:**
* **For a UE supporting R17 paging enhancement feature, it is RAN1 understanding that it is up to UE implementation whether the UE monitors the MO(s) for a PEI (No RAN1 spec impact)**
	+ **If UE decides to not to monitor PEI, it has to monitor UE’s PO as defined in 38.304 (No RAN1 spec impact)**
 |
| OPPO | UE is not required to monitor a PO if UE does not detect PEI at all PEI occasion(s) for the PO when provided the parameter for detection of a DCI format 2\_7 in RRC\_IDLE state or in RRC\_INACTIVE state. |
| Nokia | **Proposal: The PDCCH monitoring occasions defined by** *peiSearchSpace* **colliding with UL symbols are omitted from the determination of the PEI monitoring occasions. The PDCCH monitoring occasions for PEI which do not overlap with UL symbols (determined according to *tdd-UL-DL-ConfigurationCommon*) are sequentially numbered from zero starting from the first PDCCH monitoring occasion for paging in the PF.****Proposal: Support also *searchSpaceSetZero* for PEI monitoring.**  |
| Intel  |  |
| Panasonic |  |
| Apple | **Proposal 1: All the UEs in a cell determine the mapping of PEI to POs/PFs based on a reference DRX cycle, which is signaled by the gNB in SIB. The gNB shall guarantee that the DRX cycle of any UE is not smaller than the reference DRX cycle.****Proposal 2: To address the potential issue for UEs not configured with subgrouping, adopt one of the following alternatives:*** **Option 1: mandate that (1) all UEs supporting PEI also support subgrouping; (2) gNB is required to configure subgrouping for a capable UE if PEI is enabled.**
* **Option 2: For a UE monitoring PEI but not configured with subgrouping,**
	+ **Alt 1: Add a separate bit in the PEI field for UEs not configured with subgrouping**
	+ **Alt 2: Use the last bit for a PO in the PEI field for UEs not configured with subgrouping, and introduce a separate parameter for the number of subgroups for UE to derive the subgroup ID for UE\_ID-based subgrouping.**

**Proposal 4: Support separate PO configurations for UEs supporting sub-grouping and UEs not supporting sub-grouping.** |
| xiaomi | ***Proposal 1:*** ***SFN of the first PF of the PF(s) associated with the PEI-O should be defined. SFN of “the first PF” = SFN of UE’s PF -*** ***.******Proposal 2: If PEI search space reuses paging search space, PEI DCI will not wake up UE if there is only short message, PEI DCI will only wake up UE if there is paging message or paging message plus short message.******Proposal 3: If PEI search space reuses paging search space, UE can directly try to decode the paging DCI in the same monitoring occasion carrying PEI, to get the short messages.******Proposal 4: If PEI search space reuses paging search space, PEI DCI size should be aligned with paging DCI size.******Proposal 5: If PEI search space does not reuse paging search space,*** ***no reserved bits would be needed for PEI.*** ***PEI DCI size is only the sum of total number of bits for paging indication filed and TRS availability indication field, if configured.*** |
| Ericsson | Proposal 9: No special handling is introduced for PEI when eDRX PTW is configured (if eDRX PTW is supported). The UE wakes up at configured PTW during which PEI is applicable to the POs within. |
| Lenovo, Motorola Mobility |  |
| Transsion |  |
| LG Electronics |  |
| CMCC | **Proposal 4. The TP suggestion for TS 38.213 section 10.1 is as the following:****<**Unchanged text is omitted>If a UE is provided - one or more search space sets by corresponding one or more of *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *ra-SearchSpace*, *peiSearchSpace* or a CSS set by *PDCCH-Config*, and - a SI-RNTI, a P-RNTI, a RA-RNTI, a MsgB-RNTI, a PEI-RNTI, a SFI-RNTI, an INT-RNTI, a TPC-PUSCH-RNTI, a TPC-PUCCH-RNTI, or a TPC-SRS-RNTIthen, for a RNTI from any of these RNTIs, the UE does not expect to process information from more than one DCI format with CRC scrambled with the RNTI per slot.**<**Unchanged text is omitted> |
| MediaTek  | Observation 2: UE expects at most one PEI outcome from each PEI monitoring occasion.Proposal 5: The following text proposal to Section 10.1 of TS 38. 213 is adopted:

|  |
| --- |
| \*\*\* Unchanged text is omitted \*\*\*If a UE is provided - one or more search space sets by corresponding one or more of *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *peiSearchSpace, ra-SearchSpace*, or a CSS set by *PDCCH-Config*, and - a SI-RNTI, a P-RNTI, a PEI-RNTI, a RA-RNTI, a MsgB-RNTI, a SFI-RNTI, an INT-RNTI, a TPC-PUSCH-RNTI, a TPC-PUCCH-RNTI, or a TPC-SRS-RNTIthen, for a RNTI from any of these RNTIs, the UE does not expect to process information from more than one DCI format with CRC scrambled with the RNTI per slot.\*\*\* Unchanged text is omitted \*\*\* |

 |
| Nordic Semiconductor ASA | ***Proposal-2:*** *If nrofCandidates is not configured, number of candidates for PEI CSS is given by Table 10.1-1 in TS38.213** *Note: This allows gNB to reduce SIB1 overhead by 15bits*

|  |
| --- |
| **Proposed conclusion:**Alt 1: It is up to UE implementation whether the UE monitors the MO(s) for a PEI* If UE decides to not to monitor PEI, it has to monitor UE’s PO as defined in 38.304
 |

It has been agreed that a frame offset of PEI frame form PO frame is configured by gNB. As a consequence, a gNB saving resources and UE with unfortunate paging frame location may not achieve power-saving. Therefore, it should be up to UE implementation whether UE monitors MO(s) for PEI or monitors as in legacy, when a gNB configuration cannot achieve power saving. If Conclusion is agreed, RAN2/4 should be informed.***Proposal-3:*** *Conclude above Alt 1 and inform RAN2/RAN4 about the conclusion.* |
| InterDigital |  |
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For the case one PEI-O is associated with POs of 2 PFs, the following proposals of, suggested by a) Qualcomm and b) xiaomi, respectively, will be useful to simplify and clarify UE processing. In this regard, companies are encouraged to check Proposal 4-1 and provide comments/suggested changes in the table below.

**Proposal 4-1:**

**If one PEI-O is associated with POs of 2 PFs,**

1. **If two PFs are associated with a PEI, the two PFs belong to the same paging cycle.**
2. **SFN of the first PF of the PF(s) associated with the PEI-O should be defined. SFN of “the first PF” = SFN of UE’s PF -** **.**



Table 8: Companies’ comments/suggested changes to Proposal 4-1

|  |  |
| --- | --- |
| Company | Companies’ comments/suggested changes |
| Nordic | We support |
| Xiaomi | Support the proposal. |
| Spreadtrum | We prefer the equation like PF. However, if it is the majority view, we can live with it. |
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In the final round of email discussion, the following conclusion is close to be agreed/approved. Principally, the conclusion is to allow UE’s freedom in PEI monitoring, subject to PO performance guarantee. Companies are encouraged to check Conclusion 4-2 and provide comments/suggested changes in the table below.

**Conclusion 4-2** (left-over from RAN1#107-e email discussion):

***For a UE supporting R17 paging enhancement feature, it is up to UE implementation whether the UE monitors the MO(s) for a PEI.***

* ***If UE decides to not to monitor PEI, it has to monitor UE’s PO as defined in 38.304.***

Table 9: Companies’ comments/suggested changes to Conclusion 4-2

|  |  |
| --- | --- |
| Company | Companies’ comments/suggested changes |
| Nordic | We support |
| Xiaomi | Support the proposal. |
| Spreadtrum | Support. gNB should have large flexibility to place the PEI, and UE should have freedom to ignore the PEI which is not power efficient for detection. |
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During the discussion on feature CR to TS 38.213, spec editor suggests further discussion on whether to include PEI monitoring in the following paragraph. The paragraph is to state that UE only expects one PEI outcome from each PDCCH MO of PEI-O. Given the analogy to PO, the following proposal is suggested, and companies are encouraged to provide comments/suggested changes to Proposal 4-3 in the table below.

**Proposal 4-3**:

**UE expects at most one PEI outcome from each PDCCH monitoring occasion of PEI-O, and the following text proposal is adopted.**

|  |
| --- |
| **Section 10.1 of TS 38. 213**\*\*\* Unchanged text is omitted \*\*\*If a UE is provided - one or more search space sets by corresponding one or more of *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *peiSearchSpace, ra-SearchSpace*, or a CSS set by *PDCCH-Config*, and - a SI-RNTI, a P-RNTI, a PEI-RNTI, a RA-RNTI, a MsgB-RNTI, a SFI-RNTI, an INT-RNTI, a TPC-PUSCH-RNTI, a TPC-PUCCH-RNTI, or a TPC-SRS-RNTIthen, for a RNTI from any of these RNTIs, the UE does not expect to process information from more than one DCI format with CRC scrambled with the RNTI per slot.\*\*\* Unchanged text is omitted \*\*\* |

Table 10: Companies’ comments/suggested changes to Proposal 4-3

|  |  |
| --- | --- |
| Company | Companies’ comments/suggested changes |
| Nordic  | We support |
| Xiaomi | Support the proposal. |
| Spreadtrum | Fine |
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# Other Issues

In Table 11, companies’ additional proposals are collected:

Table 11

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| --- | --- |
| Company | Companies’ views and proposals |
| Huawei, HiSilicon |  |
| ZTE, Sanechips | The transmission power of PEI needs to be determined. And the transmission power determination method of paging PDCCH can be reused. |
| vivo |  |
| CATT |  |
| TCL |  |
| Samsung |  |
| DOCOMO | In NR paging, UE determines PO (Paging Occasion) for the UE based on the calculation by e.g., UE ID, and the PO includes PDCCH monitoring occasion(s) which corresponds to each SSB. A PO can consist of a set of monitoring occasions corresponding to different beams in multi-beam operations. A large number of UEs share the same PO. These UEs wake up to monitor paging PDCCH in the same PO and have to receive corresponding PDSCH including paging message. If the paging message does not have the information for UEs, power consumption increases by unnecessary paging reception. … In the last meeting, we also agreed to support configurable DCI payload size which should be no larger than payload size of paging DCI and unused bits, when applicable, are regarded as reserved bits. In my understanding of it, **there is a room to introducing Short Message in PEI**. |
| Spreadtrum  | For the DCI size, it was agreed that it should be no larger than paging DCI size. To reduce the DCI size of DCI format 2\_7 for better PEI detection performance, we prefer the DCI size is configurable independent of the paging DCI size.***Proposal 1: The DCI size of DCI format 2\_7 is configurable independent of the paging DCI size.*** |
| Qualcomm  | **Proposal 6: If the working assumption for RedCap separate initial DL BWP that “If it is configured for paging, RedCap UE expects it to contain NCD-SSB for serving cell” is agreed, network configures PEI in the separate initial DL BWP.** |
| OPPO |  |
| Nokia | **Proposal:** **Network flexibility to choose in which cells/beams paging is sent, should be maintained and applied also to PEI.** **Proposal: To enable/disable broadcast beam specific PEI, bit map could be used to indicate the SSBs to which the PEI is active.** |
| Intel  | **Proposal 2: TRS availability indication field is always included in PEI DCI if SIB configures TRS resource.*** **Bits of TRS availability indication field starts after the paging indication field.**

**Proposal 3: Bit size of TRS availability indication field is same in PEI DCI and paging DCI.****Proposal 5: UE may follow TRS availability indication by PEI regardless of whether UE is indicated to monitor PO or not by the same PEI.** |
| Panasonic |  |
| Apple | **Proposal 3: It is supported that UE transmits assistance information on the preferred offset between PEI and PO, in unit of number of SSBs in between.** |
| xiaomi |  |
| Ericsson | Observation 1: Use of reserved bits in paging DCI (as a PDCCH-PEI) in one PO as paging early indication for UEs in one or more groups in other POs can further reduce PEI signalling overhead and NW power consumption.Observation 2: Reusing a predefined RNTI for PEI detection and a fixed payload position limits the possibility to multiplex PDCCH PEI on top of a PDCCH PO.Observation 3: Compared to a predefined RNTI, a configurable RNTI for PEI and configurable payload position does not introduce considerable complexity for the UEs.Proposal 1: PEI design should allow the use of reserved bits in paging DCI in one PO as paging early indication for UEs in one or more groups in other POs.Proposal 4: PEI design should allow configurable start position of the payload, bits before this starting point are treated as reserved bits by the UE.Proposal 5: The locations (start position) of the following information elements within the PEI DCI is configurable via higher layer broadcast configuration:- Start of paging indication field (S1), 0≤S1 ≤42- Start of TRS availability indication field (S2), 0≤S2 ≤42 |
| Lenovo, Motorola Mobility | **Proposal 1: Support a DCI format 2\_7 configuration in an RRC release message for an RRC inactive mode UE.**  |
| Transsion | ***Proposal 1: If UE decides to not to monitor PEI, it has to monitor UE’s PO as defined in 38.304.*** |
| LG Electronics | **Observation 1: Once the SI change indication is transmitted, repetitions of SI change indication may occur within preceding modification period.** **Observation 2: Conveying information with regard to SI change indication and/or ETWS/CMAS notification over PEI is beneficial from power saving perspective.****Observation 3: Compared to the Alt 1-a, conveying information with regard to SI change indication and/or ETWS/CMAS notification over PEI does not increase the NW overhead.****Proposal 3: Support two bits indication over PEI for SI change indication and ETWS/CMAS notification** |
| CMCC |  |
| MediaTek  |  |
| Nordic Semiconductor ASA | ***Observation-1:*** *For Idle UEs, gNB must avoid overlapping of CORESET#0/CommonCORESET and PDSCH. For RRC connected UEs, gNB may configure UE to rate-match dynamically around entire CORESET#0/CommonCORESET (as mandatory feature).****Observation-2:*** *When**gNB indicates transmitting PDCCH DMRS in entire CORESET#0/CommonCORESET, the UE may use DMRS as sequence-based detection of PEI presence and/or to facilitate PDCCH DMRS for consequent finer-synchronization. There is clear benefit for UE.****Proposal-4****: Consider introducing PDCCH DMRS transmitted in an entire CORESET#0/CommonCORESET configured by SIB1/MIB during PEI monitoring occasions to facilitate sequence-based detection of PEI presence and/or to facilitate PDCCH DMRS for consequent finer-synchronization.*Regarding whether and how to support separate PO configuration, we believe it would be beneficial e.g. in case of PO determination would be different for R17 UEs supporting iTRS, as proposed in Proposal-3. Transmit power of PEI should be the same as for other CSS PDCCH. |
| InterDigital |  |
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From the above, PEI transmission power is one fundamental performance aspect. Accordingly, the following proposal is suggested, and companies please provide comments/suggested changes to Proposal 5-1 in the table below.

**Proposal 5-1:**

**The transmission power of PEI is based on the same determination method as paging PDCCH, and the following TP is adopted:**

|  |
| --- |
| ................................................................ Text Proposal for 38.213..................................................................................4.1 Cell searchCell search is the procedure for a UE to acquire time and frequency synchronization with a cell and to detect the physical layer Cell ID of the cell. A UE receives the following synchronization signals (SS) in order to perform cell search: the primary synchronization signal (PSS) and secondary synchronization signal (SSS) as defined in [4, TS 38.211]. A UE assumes that reception occasions of a physical broadcast channel (PBCH), PSS, and SSS are in consecutive symbols, as defined in [4, TS 38.211], and form a SS/PBCH block. The UE assumes that SSS, PBCH DM-RS, and PBCH data have same EPRE. The UE may assume that the ratio of PSS EPRE to SSS EPRE in a SS/PBCH block is either 0 dB or 3 dB. If the UE has not been provided dedicated higher layer parameters, the UE may assume that the ratio of PDCCH DMRS EPRE to SSS EPRE is within -8 dB and 8 dB when the UE monitors PDCCHs for a DCI format 1\_0 with CRC scrambled by SI-RNTI, P-RNTI, or RA-RNTI, and DCI format 2\_7 with CRC scrambled by PEI-RNTI. ............................................................... Text Proposal for 38.213.................................................................................. |

Table 12: Companies’ comments/suggested changes to Proposal 5-1

|  |  |
| --- | --- |
| Company | Companies’ comments/suggested changes |
| Nordic  | We support |
| Xiaomi | Support the proposal. |
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Regarding sharing the resource with paging DCI, Ericsson further suggests one solution to embed PEI DCI fields to the reserved bits of paging DCI. The intention is to minimize the resource overhead when there is transmitted paging DCI for other UEs. To enable such sharing, being able to adjust the start of the paging indication field and TRS indication field is needed. To allow flexible implementation for paging early indication, companies are encouraged to check the Proposal 5-2 and provide your views in the table below.

**Proposal 5-2:**

**The locations (start position) of the following information elements within the PEI DCI is configurable via higher layer broadcast configuration:
- Start of paging indication field (S1), 0≤S1 ≤42
- Start of TRS availability indication field (S2), 0≤S2 ≤42**

Table 13: Companies’ views on whether/how to support Proposal 5-2

|  |  |
| --- | --- |
| Company | Companies’ views |
| Nordic | We support |
| Xiaomi | Not support the proposal. we do not see why such explicit configuration is needed. from our understanding, paging DCI is the first field, and TRS availability indication field is the second field, and its start position is based on the configuration of subgrouping number and PEI-PO mapping in SIB. |
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Because of the flexibility of PEI DCI format 2\_7, there are multiple companies suggesting inclusion of a 2-bit short message field in the DCI format. Since there is constant support on the short message field, moderator would like to suggest companies’ check and provision of views on whether/how to include a 2-bit short message field.

**Proposal 5-3:**

**Support two bits indication in DCI format 2\_7 for SI change indication and ETWS/CMAS notification.**

Table 14: Companies’ views on whether/how to support Proposal 5-3

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| Company | Companies’ views |
| Nordic | We do not support |
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# Summary

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16. R1-2200362, “Open items on paging enhancements for UE power saving”, Nokia, Nokia Shanghai Bell
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18. R1-2200397, “On paging enhancement”, Panasonic
19. R1-2200417, “Remaining issues on paging enhancements for idle/inactive UEs”, Apple
20. R1-2200463, “Remaining issues on paging enhancement for power saving”, xiaomi
21. R1-2200478, “Remaining aspects of Paging Enhancements”, Ericsson
22. R1-2200532, “Paging enhancement for UE power saving”, Lenovo, Motorola Mobility
23. R1-2200560, “Discussion on PEI Design”, Transsion Holdings
24. R1-2200575, “Discussion on potential paging enhancements”, LG Electronics
25. R1-2200585, “Remaining issues on paging early indication”, CMCC
26. R1-2200606, “Maintenance on Design of Paging Early Indication”, MediaTek Inc.
27. R1-2200609, “On paging early indication”, Nordic Semiconductor ASA
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