**3GPP TSG-RAN WG2 Meeting #116bis-e R2-220xxxx**

**Electronic, 17th Jan. – 25th Jan. 2022**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.304** | **CR** | **Draft** | **rev** | **-** | **Current version:** | **16.6.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | 38.304 Running CR for ePowSav | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | vivo | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_UE\_pow\_sav\_enh-Core | | | | |  | ***Date:*** | | | 2022-1-11 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | To capture agreements for ePowSav in NR into TS 38.304.  This is a draft of 38.304 running CR for ePowSav. To be updated based on the progress on ePowSav in both RAN1 and RAN2. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Introduction of ePowSav features in NR.  This CR captures the idle/inactive aspects of enhanced power saving and it is based on the RAN2/RAN1 agreements made so far, which could be found in Annex at the end of this document. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | ePowSav is not supported in NR in TS 38.304. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | TBD | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS/TR 38.331 CR TBD  TS/TR 38.306 CR TBD  TS/TR 38.321 CR TBD  TS/TR 38.300 CR TBD | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | | This CR should be lifted to the latest version of the specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | This is the updated version of running CR for TS 38.304 for ePowSav WI considering conclusions from RAN1#117e. | | | | | | | | |

Start of change

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

AS Access Stratum

CAG Closed Access Group

CAG-ID Closed Access Group Identifier

CMAS Commercial Mobile Alert System

CN Core Network

CSI-RS Channel State Information Reference Signal

DCI Downlink Control Information

ETWS Earthquake and Tsunami Warning System

E-UTRA Evolved UMTS Terrestrial Radio Access

E-UTRAN Evolved UMTS Terrestrial Radio Access Network

HRNN Human-Readable Network Name

IAB Integrated Access and Backhaul

IMSI International Mobile Subscriber Identity

MCC Mobile Country Code

MICO Mobile Initiated Connection Only

NAS Non-Access Stratum

NID Network Identifier

NPN Non-Public Network

NR NR Radio Access

PEI Paging Early Indication [FFS]

PLMN Public Land Mobile Network

RAT Radio Access Technology

RNA RAN-based Notification Area

RNAU RAN-based Notification Area Update

RRC Radio Resource Control

SNPN Stand-alone Non-Public Network

UAC Unified Access Control

UE User Equipment

UMTS Universal Mobile Telecommunications System

V2X Vehicle to Everything

Next change

7 Paging

7.1 Discontinuous Reception for paging

The UE may use Discontinuous Reception (DRX) in RRC\_IDLE and RRC\_INACTIVE state in order to reduce power consumption. The UE monitors one paging occasion (PO) per DRX cycle. A PO is a set of PDCCH monitoring occasions and can consist of multiple time slots (e.g. subframe or OFDM symbol) where paging DCI can be sent (TS 38.213 [4]). One Paging Frame (PF) is one Radio Frame and may contain one or multiple PO(s) or starting point of a PO.

In multi-beam operations, the UE assumes that the same paging message and the same Short Message are repeated in all transmitted beams and thus the selection of the beam(s) for the reception of the paging message and Short Message is up to UE implementation. The paging message is same for both RAN initiated paging and CN initiated paging.

The UE initiates RRC Connection Resume procedure upon receiving RAN initiated paging. If the UE receives a CN initiated paging in RRC\_INACTIVE state, the UE moves to RRC\_IDLE and informs NAS.

The PF and PO for paging are determined by the following formulae:

SFN for the PF is determined by:

(SFN + PF\_offset) mod T = (T div N)\*(UE\_ID mod N)

Index (i\_s), indicating the index of the PO is determined by:

i\_s = floor (UE\_ID/N) mod Ns

The PDCCH monitoring occasions for paging are determined according to *pagingSearchSpace* as specified in TS 38.213 [4] and *firstPDCCH-MonitoringOccasionOfPO* and *nrofPDCCH-MonitoringOccasionPerSSB-InPO* ifconfigured as specified in TS 38.331 [3]. When *SearchSpaceId* = 0 is configured for *pagingSearchSpace*, the PDCCH monitoring occasions for paging are same as for RMSI as defined in clause 13 in TS 38.213 [4].

When *SearchSpaceId* = 0 is configured for *pagingSearchSpace*, Ns is either 1 or 2. For Ns = 1, there is only one PO which starts from the first PDCCH monitoring occasion for paging in the PF. For Ns = 2, PO is either in the first half frame (i\_s = 0) or the second half frame (i\_s = 1) of the PF.

When *SearchSpaceId* other than 0 is configured for *pagingSearchSpace,* the UE monitors the (i\_s + 1)th PO. A PO is a set of 'S\*X ' consecutive PDCCH monitoring occasions where 'S' is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1* and X is the *nrofPDCCH-MonitoringOccasionPerSSB-InPO* if configured or is equal to 1 otherwise. The [x\*S+K]th PDCCH monitoring occasion for paging in the PO corresponds to the Kth transmitted SSB, where x=0,1,…,X-1, K=1,2,…,S. The PDCCH monitoring occasions for paging 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. When *firstPDCCH-MonitoringOccasionOfPO* is present, the starting PDCCH monitoring occasion number of (i\_s + 1)th PO is the (i\_s + 1)th value of the *firstPDCCH-MonitoringOccasionOfPO* parameter; otherwise, it is equal to i\_s \* S\*X. If X > 1, when the UE detects a PDCCH transmission addressed to P-RNTI within its PO, the UE is not required to monitor the subsequent PDCCH monitoring occasions for this PO.

NOTE 1: A PO associated with a PF may start in the PF or after the PF.

NOTE 2: The PDCCH monitoring occasions for a PO can span multiple radio frames. When *SearchSpaceId* other than 0 is configured for *paging-SearchSpace* the PDCCH monitoring occasions for a PO can span multiple periods of the paging search space.

The following parameters are used for the calculation of PF and i\_s above:

T: DRX cycle of the UE (T is determined by the shortest of the UE specific DRX value(s), if configured by RRC and/or upper layers, and a default DRX value broadcast in system information. In RRC\_IDLE state, if UE specific DRX is not configured by upper layers, the default value is applied).

N: number of total paging frames in T

Ns: number of paging occasions for a PF

PF\_offset: offset used for PF determination

UE\_ID: 5G-S-TMSI mod 1024

Parameters *Ns*, *nAndPagingFrameOffset*, *nrofPDCCH-MonitoringOccasionPerSSB-InPO*, and the length of default DRX Cycle are signaled in *SIB1*. The values of N and PF\_offset are derived from the parameter *nAndPagingFrameOffset* as defined in TS 38.331 [3]. The parameter *first-PDCCH-MonitoringOccasionOfPO* is signalled in *SIB1* for paging in initial DL BWP.For paging in a DL BWP other than the initial DL BWP, the parameter *first-PDCCH-MonitoringOccasionOfPO* is signaled in the corresponding BWP configuration.

If the UE has no 5G-S-TMSI, for instance when the UE has not yet registered onto the network, the UE shall use as default identity UE\_ID = 0 in the PF and i\_s formulas above.

5G-S-TMSI is a 48 bit long bit string as defined in TS 23.501 [10]. 5G-S-TMSI shall in the formulae above be interpreted as a binary number where the left most bit represents the most significant bit.

7.x PEI

7.x.1 PEI reception

The UE may use PEI in RRC\_IDLE and RRC\_INACTIVE state in order to reduce power consumption. If PEI configuration is provided in system information, the UE in RRC\_IDLE or RRC\_INACTIVE state supporting PEI can monitor PEI using PEI parameters in system information according to the procedure described below.

If [TBD] is configured, PEI is only used by the UE in the cell in which [TBD the UE most recently entered RRC\_IDLE or RRC\_INACTIVE].

Editor’s NOTE: The detailed procedure may be updated based on RAN1 agreements.

Editor’s NOTE: FFS how the configuration is provided in [SI, RRCRelease, or NAS message].

The UE monitors one PEI occasion per DRX cycle. A PEI occasion (PEI-O) is a set of PDCCH monitoring occasions and can consist of multiple time slots (e.g. subframe or OFDM symbol) where PEI can be sent (TS 38.213 [4]).

The time location of PEI-O for UE’s PO is determined by a reference point and an offset from the reference point to the start of the first PDCCH monitoring occasionMO of this PEI-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, provided by *PEI-F\_offset* and configured via SIB for the cell;

The offset 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.

Editor’s NOTE: Whether to add the note according to RAN1 agreement: PEI-O can be configured by network to be placed close to or overlapped with an earlier SS burst before its associated POs.

The PDCCH monitoring occasions for PEI are determined according to *pei-SearchSpace* as specified in TS 38.213 [4], *PEI-F\_offset*, *firstPDCCH-MonitoringOccasionOfPEI-O* and *nrofPDCCH-MonitoringOccasionPerSSB-InPO* ifconfigured as specified in TS 38.331 [3].

When *SearchSpaceId* other than 0 is configured for *peiSearchSpace,* the UE monitors the PEI occasion according to *SearchSpaceId*.

A PEI occasion is a set of ‘S\*X’consecutive PDCCH monitoring occasions, where 'S' is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1*, and X is the *nrofPDCCH-MonitoringOccasionPerSSB-InPO* if configured or is equal to 1 otherwise. The [x\*S+K]thPDCCH monitoring occasion for PEI in the PEI occasion corresponds to the Kth transmitted SSB, where x=0,1,…,X-1, K=1,2,…,S. [TBD: 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 PEI.] If X > 1, when the UE detects a PEI within its PEI-O, the UE is not required to monitor the subsequent monitoring occasion(s) associated with the same PEI-O.

Editor’s NOTE: FFS how to number the PDCCH monitoring occasions for PEI.

Editor’s NOTE: The detailed parameters for PEI reception will be aligned with RRC specification.

When the UE detects PEI, and the PEI indicates the UE (or the subgroup the UE belongs to, as specified in clause 7.y) to monitor the associated PO, as specified in clause 10.4a in TS 38.213 [4], the UE monitors the associated PO as specified in clause 7.1. If the UE does not detect PEI on the monitored PEI occasion or the PEI does not indicate the UE (or the subgroup the UE belongs to, as specified in clause 7.y) to monitor the associated PO, as specified in clause 10.4a in TS 38.213 [4], the UE is not required to monitor the associated PO as specified in clause 7.1.

Editor’s NOTE: As a baseline RAN2 has a preference to support PEI with both DRX and eDRX, but potential issues (e.g. PEI and PTW) are FFS.

If the UE is unable to monitor the PEI occasion (i.e. all valid PDCCH monitoring occasion for PEI) corresponding to its PO, e.g. during cell re-selection, the UE monitors the associated PO according to clause 7.1.

Editor’s NOTE: Companies are invited to provide suggestions on the wording of this behaviour.

Editor’s NOTE: RAN2 aims to Support PEI and subgrouping with eDRX. FFS the impact.

Editor’s NOTE: RAN2 assumes that PEI can be used “without” subgrouping. FFS whether the bits in the PEI for subgrouping then need to have any particular meaning, or whether this would be done by just having one subgroup.

7.y Subgrouping [FFS]

Editor’s NOTE: FFS: Whether to have a separate clause for subgrouping or merge it into the previous clause for PEI in 7.x as a subclause (e.g. 7.x.y) would be further decided after the decision on UE capability and detailed design for PEI and subgrouping.

7.y.0 General

If *subgroupConfig-r17* is configured, UEs monitoring the same PO can be divided into one or more subgroups. With subgrouping, the UE monitors PO if the subgroup the UE belongs to is indicated by PEI corresponding to its PO, as specified in clause 10.4a in TS 38.213 [4]. UE’s subgroup can be either assigned by CN as specified in clause 7.y.1 or determined based on UE\_ID as specified in clause 7.y.2:

- If *subgroupConfig* is configured and Nsg-UEID is absent, the subgroup ID based on CN assigned subgrouping as specified in clause 7.y.1 is used in the cell.

- If both *subgroupConfig* and Nsg-UEID are configured, and Nsg-UEID has the same value as *subgroupsNumPerPO*, the subgroup ID based on UE\_ID based subgrouping as specified in clause 7.y.2 is used in the cell.

- If both *subgroupConfig* and Nsg-UEID are configured, and 0 < Nsg-UEID < *subgroupsNumPerPO*, the subgroup ID based on CN assigned subgrouping as specified in clause 7.y.1 and the subgroup ID based on UE\_ID based subgrouping as specified in clause 7.y.2 are used in the cell.

The following parameters are used for the determination of subgroup ID:

subgroupsNumPerPO: number of subgroups for total CN assigned subgrouping (if any) and UE\_ID based subgrouping (if any) in a PO, which is broadcasted in system information

Nsg-UEID: number of subgroups for UE\_ID based subgrouping in a PO, which is broadcasted in system information

If *subgroupConfig-r17* is absent, UE subgrouping is not supported in the cell, and the UE monitors PEI as specified in clause 7.x, if supported, or its associated PO as specified in clause 7.1.

Editor’s NOTE: FFS for the signalling details.

7.y.1 CN assigned subgrouping

Editor’s NOTE: FFS on the terminology for CN assigned subgrouping. Companies are invited to provide your suggestion.

A UE supporting CN assigned subgrouping in RRC\_IDLE or RRC\_INACTIVE state can be assigned a subgroup ID (between 0 to 7) by AMF through NAS signalling. The UE belonging to the assigned subgroup ID monitors its associated PEI which includes the paged subgroup(s) as specified in clause 7.x.

Editor’s NOTE: FFS on the detailed NAS signalling between AMF and UE. The design and procedure are up to SA2/CT1.

Editor’s NOTE: R2 assumes that all the cells within the registration area supports the same number of CN assigned subgroups, i.e. no remapping of CN assigned group ID to RAN subgroup ID.

7.y.2 UE\_ID based subgrouping

Editor’s NOTE: FFS on the terminology for UE\_ID based subgrouping. Companies are invited to provide your suggestion.

If a UE supporting UE\_ID based subgrouping is not configured with a CN assigned subgroup ID or if a UE supports only UE\_ID based subgrouping (i.e. does not support CN assigned subgrouping), the subgroup ID of the UE is determined by below formula:

SubgroupID = (floor(UE\_ID/(N\*Ns)) mod Nsg\_UEID) + (subgroupNumPerPO - Nsg-UEID),

where:

N: number of total paging frames in T

Ns: number of paging occasions for a PF

UE\_ID: 5G-S-TMSI mod X, where X is 8192

Nsg-UEID: number of subgroups for UE\_ID based subgrouping in a PO, which is broadcasted in system information

Editor’s NOTE: The detailed parameters for UE\_ID based subgrouping will be aligned with RRC specification.

Editor’s NOTE: For the cases when UE cannot determine its subgroup based on the configuration of a cell, or cannot find the corresponding bit for its subgroup in the PEI, e.g. UE only supports UEID-based and the cell only supports CN-assigned, FFS whether these cases are valid, how to determine UE subgrouping, or how to monitor paging for these cases.

The UE belonging to the SubgroupID monitors its associated PEI which includes the paged subgroup(s) as specified in clause 7.x.

Next change

Z TRS

Z.1 General

The UE in RRC\_IDLE and RRC\_INACTIVE state may use TRS whose configurations are provided in system information by network during its paging reception to save power. In a cell in which TRS are available for the UE in RRC\_IDLE and RRC\_INACTIVE state to use, the availability of indicated TRS is informed to the RRC\_IDLE and RRC\_INATIVE state UEs based on explicit L1 based signaling defined in TS 38.213 [4].

Editor’s NOTE: R2 assumes that additional TRS configuration by dedicated signalling is not supported. Can revisit e.g. based on R1 provided info if needed.

Z.2 TRS reception

Editor’s NOTE: Companies are invited to provide comments on whether this part needs to be captured here or only captured in PHY specification.

When the UE receives the configuration of TRS in SIBx,

- If PEI is detected as specified in clause 7.x.1, and the availability indication(s) in PEI indicates that the TRS at the configured occasion(s) is available, as specified in TS 38.213 [4]; or,

- If the availability indication(s) in paging PDCCH (according to clause 7) indicates that the TRS at the configured occasion(s) is available, as specified in TS 38.213 [4]:

- the UE considers the corresponding TRS configuration associated with the availability indication(s) is available for a time duration, as specified in TS 38.213 [4].

Editor’s NOTE: RAN2 confirm TRS can be applied to eDRX UEs.

Editor’s NOTE: Whether to have UE capability on TRS would be further decided.

Editor’s NOTE: A UE which acquired SIB-X with a TRS configuration but didn’t yet receive an associated L1-based availability indication considers the configured TRS as FFS “unavailable” or “available”.

End of change

Annex A– RAN2 agreements

### Agreements on paging enhancement

|  |  |  |
| --- | --- | --- |
| **RAN2 agreements** | **Impacted specification** | **Comments, if any** |
| **RAN2#111e** | | |
| For PowSav solutions for Idle/Inactive (for smart phones) that can easily also be applied to redcap, R2 assume they may be applied. Details FFS and to be discuss case by case when the maturity is high (might in the end just be a question of UE caps).  Dual DRX not in the scope of current WID. | No impact |  |
|  |  |  |
| **RAN2#112e** | | |
| Confirm that UE grouping is considered a candidate of paging enhancement for UE power saving | Not yet captured to wait for further progress. |  |
| RAN2 have discussed and considered “paging indication for UE subgroups using paging DCI”, “paging early indication or wake-up signal (WUS) for UE subgroups”, “cross-slot scheduling of paging for UE subgroups”.  RAN2 understands that RAN1 have started to evaluate performance and complexity. RAN2 assumes that RAN1 continues with this evaluation, in order that decisions can be made regarding the paging indication/scheduling solution. As R2 is the leading group for this WI objective it is expected that final decisions are made by R2.  Will send an LS to R1 (action to be discussed offline).  The solution of PRNTI based group discrimination is deprioritized from RAN2 perspective  The solution of “paging for UE subgroups using different time/frequency resources” is de-prioritized from RAN2 perspective. | No impact |  |
| **RAN2#113e** | | |
| There is support to have UE ID based enhancement  There is still significant interest to have other additional methods (but also some concerns). The approach to have a single mechanism that can take several aspects into account can be a way forward. There are still questions on the details, e.g. whether CN or RAN would provide a parameter. | No impact |  |
|  |  |  |
| **RAN2#113bis-e** | | |
| If we go for network controlled subgrouping, If the network chooses to not provide specific subgrouping information, there will be configuration option where subgrouping can be supported by randomization (by UE-ID). | Captured in 7.y.2 |  |
| We adopt Network controlled subgrouping (based on individual UE characteristics, not specified or limited to paging prob as EUTRA, possibly with additional randomization) | Not yet captured to wait for further progress. |  |
|  |  |  |
| **RAN2#114e** | | |
| CN is responsible for allocating UEs to UE paging subgroups based on UE characteristics | Captured in 7.y.1 |  |
| Use same UE subgroups when in RRC\_IDLE and RRC\_INACTIVE | Captured in 7.y |  |
|  |  |  |
| **RAN2#115e** | | |
| When AMF has assigned a UE with a Paging subgroup, some NAS signaling should be supported between AMF and UE to convey the related information to the UE. Exact information is FFS. The design and procedure are up to SA2/CT1. | Captured in 7.y.1 |  |
| When AMF has assigned a UE with a Paging subgroup, some signaling should be supported between AMF and gNB(s) to inform gNB(s) about the related subgroup information for paging a UE in RRC\_IDLE/RRC\_INACTIVE. Exact information is FFS. The message(s) and associated design are up to RAN3. | Captured in 7.y.1 |  |
| It is FFS when a UE in RRC\_INACTIVE has been assigned by CN a Paging subgroup, whether some signaling should be introduced between gNBs to inform each other about the UE’s subgroup for RAN paging. | No impact by now |  |
| If RAN2 agrees to support UE assistance information to CN in support of Paging subgroup assignment, RAN2 will focus on the paging probability and power profile attributes. | No impact by now |  |
| UEID-based subgroup method requires, in addition to the already available information for legacy UEID-based grouping in PO, the total number of supported UEID-based subgroups by the network. | Captured in 7.y.2 |  |
| At least for UEID-based subgroup method the total number, Nsg, of supported subgroups by the network is decided by RAN and broadcasted in System Information. | Captured in 7.y.2 |  |
| At least for UEID-based subgroup method the total number, Nsg, of supported subgroups is controlled on a cell basis and can be different in different cells. | Captured in 7.y.2 |  |
| Option 2 is excluded  We go with Option 1  *Editor’s NOTE: option 1 and option 2 come from R2-2109094, which are:*   * ***Option 1:*** *CN assigns subgroup ID*   + *possible with or without remapping to RAN subgroup ID depends on the sub-options* * ***Option 2:*** *CN assigns a set of subgroup IDs*   + *Similar to option 1 but with multiple subgroup IDs assigned from CN and the UE needs to choose the corresponding subgroup ID based on RAN configuration* | Captured in 7.y.1 |  |
| R2 assumes that All the cells within the registration area supports the same number of CN assigned subgroups, i.e. no remapping of CN assigned group ID to RAN subgroup ID (will revisit only if serious issues are found). | Captured in 7.y.1 |  |
| For the purpose of continued discussions, R2 assumes that UE has separate UE caps for CN assigned and UEID based subgrouping, the actual decision to be taken later. | Not yet captured to wait for further progress. |  |
| RAN capability is known based on broadcast information. FFS with explicit indication or implicitly based configuration. | Captured in 7.y |  |
| **RAN2#116e** | | |
| Assume that one subgroup indication refer to either CN assigned subgroups or UE-ID based subgroup (no overlapping)  Both UE ID based and CN based subgrouping can be supported simultaneously in a cell, it is allowed to just support one of them. | Captured in 7.y.0 |  |
| FFS if the total number of CN-assigned subgroups is OAM configured. Max would be 8 as this is what RAN support. | No impact |  |
| The total number of CN-assigned subgroups that is used is not fixed can be configured up to 8 (e.g. by OAM). No impact on signalling is assumed. | No impact |  |
| RAN introduces a new parameter Nsg-UEID to indicate its support of UE-ID based subgrouping. | Captured in 7.y.2 |  |
| RAN does not support any type of subgrouping if its configuration for subgrouping is either absent or nullified (e.g. subgroupsNumPerPO is either absent or set to zero). FFS for the signalling details. | Captured in 7.y.0 |  |
| We assume separate indications for UE capability of CN based subgrouping and UEID based subgrouping.  UE’s capability of supporting the UE ID based subgrouping is reported to RAN by AS UE capability signalling while R2 assumes that UE’s capability of supporting the CN-assigned subgrouping is reported to CN by NAS signalling. | Captured in 7.y.1 and 7.y.2 |  |
| RAN2 assumes that if PEI is detected, and the PEI indicates that the UE has to monitor the associated PO, then the UE monitors paging DCI in the associated PO, including scheduling information for paging PDSCH (if included) as in legacy. This assumption may be updated based on RAN1 agreements. | Captured in 7.x.1 |  |
| As a baseline RAN2 has a preference to support PEI with both DRX and eDRX, but potential issues (e.g. PEI and PTW) are FFS. | Captured in 7.x.1 |  |
| For UE-ID based subgroups the UE identity is UE\_ID = 5G-S-TMSI mod X, where X is 8192 (1024\*8). | Captured in 7.y.2 |  |
| Introduce a *UERadioPagingInfo* IE in the *UECapabilityInformation* message in NR in Rel-17. | No impact |  |
| If the UE was not able to monitor the PEI occasion corresponding to its PO the UE shall monitor the PO. | Captured in 7.x.1 |  |
| **RAN2#116bis-e** | | |
| RAN configuration (of subgrouping) includes the two parameters Nsg-UEID (number of UEID-based subgroups) and *subgroupsNumPerPO* (total number of subgroups in a PO):  - If only CN-assigned subgrouping is used, *subgroupsNumPerPO* is present (the value then equals to the number of CN-assigned subgroups), and Nsg-UEID is absent.  - If only UEID-based subgrouping is used, *subgroupsNumPerPO* and Nsg-UEID are present, and Nsg-UEID has the same value as *subgroupsNumPerPO*.  - If both subgrouping methods are used, both *subgroupsNumPerPO* and Nsg-UEID are present, and 0 < Nsg-UEID < *subgroupsNumPerPO*. | Captured in 7.y.0 |  |
| RAN2 aims to Support PEI and subgrouping with eDRX. FFS the impact. | Captured in 7.x.1 as an EN to wait for further progress. |  |
| RAN2 assumes that there is no particular impact to Uu signalling to support RAN sharing. It is further assumed that Core Networks must have consistent policy if subgrouping is used by multiple Core Networks. | No impact |  |
| RAN2 assumes that PEI can be used “without” subgrouping. FFS whether the bits in the PEI for subgrouping then need to have any particular meaning, or whether this would be done by just having one subgroup. | Captured in 7.y.0  FFS part is assumed to be captured by RAN1. |  |
| RAN2 assumes that PEI monitoring can not be specifically enabled/disabled for individual UEs. | No impact |  |
| PEI subgroup indices are allocated to CN-assigned subgroups first. The 1st bit in the PEI bitmap corresponds to the CN-assigned subgroup #1, 2nd bit in the bitmap corresponds to the CN-assigned subgroup #2, and so on. After CN-assigned subgroups, the subsequent bits, if any, correspond to the UEID-based subgroup #1, #2, and so on. | Assuming to be Captured in RAN1 specification TS 38.212 and 38.213, and no impact to TS 38.304 |  |
| Both *subgroupNumPerPO* and Nsg-UEID range from 1 to 8. | Assuming to be Captured in RRC, and no impact to TS 38.304 |  |
| If network supports PEI but not subgrouping, the whole *SubgroupConfig-r17* is absent. The parameter *subgroupsNumPerPO* is mandatory present if *subgroupConfig-r17* is configured. | Captured in 7.y.0 |  |
| UE is configured to monitor PEI, either only in the last used cell or any other cells (after cell reselection). FFS how the configuration is provided in [SI, RRCRelease, or NAS message]. | Captured in 7.x.1 |  |
| If a cell supports both UE identity based and CN assigned subgrouping, for UEID based paging subgrouping, UE belongs to k-th paging subgroup, where  - k = [floor (UE Identity/(N\*Ns)) mod Nsg-UEID] + Nsg-CN,  - N is the number of Paging frames,  - Ns is the number of POs per paging frame,  - Nsg-UEID is the number of UEID-based paging subgroups, and  - Nsg-CN is the number of CN assigned paging subgroups (= subgroupNumPerPO - Nsg-UEID). | Captured in 7.y.2 |  |
| Paging enhancement capability(-ies) (e.g. PEI capability, UEID based subgrouping capability or the combined capability of PEI and UEID based subgrouping) are ‘optional with capability signalling’ as gNB needs to know the paging enhancement capability(-ies) to page the UE  Separate indications for UE capability of CN based subgrouping and UEID based subgrouping (confirms earlier assumption)  UE’s capability of supporting the UE ID based subgrouping is reported to RAN by AS UE capability signalling while UE’s capability of supporting the CN-assigned subgrouping is reported to CN by NAS signalling. (confirms earlier assumption). | Partially captured in 7.x.1, 7.y.1, 7.y.2.  Details assuming to be captured in RRC and TS 38.306. |  |
| Paging enhancement capability(-ies) can be included into the UERadioPagingInfo IE in the UECapabilityInformation message as agreed in RAN2#116 (i.e. Introduce a UERadioPagingInfo IE in the UECapabilityInformation message in NR in Rel-17)  gNB interprets UE’s reported UECapabilityInformation, copies the UERadioPagingInfo IE out and includes it as a container UE-RadioPagingInfo IE in the UERadioPagingInformation inter-node message to AMF | No impact |  |
| **RAN2#117e** | | |
|  |  |  |
|  |  |  |
|  |  |  |

### Agreements on TRS/CSI-RS in idle/inactive

|  |  |  |
| --- | --- | --- |
| **RAN2 agreements** | **Impacted specification** | **Comments, if any** |
| **RAN2#113e** | | |
| [041] On signalling providing the configuration of TRS/CSI-RS occasion(s) for idle/inactive UE(s):  SIB signalling is the baseline;  Other dedicated high-layer signalling methods (e.g., dedicated RRC, RRC release message, etc.) can be additionally considered with justification. It is assumed they do not work alone. | Not yet captured to wait for further progress. |  |
| [041] RAN2 will down select from the following options on SIB signalling providing the configuration of TRS/CSI-RS occasion(s) for idle/inactive UE(s):  Option 2: Existing SIB, other than SIB1;  Option 3: New SIB type, e.g. SIB-x; | Not yet captured to wait for further progress. |  |
|  |  |  |
| **RAN2#114e** | | |
| N/A |  |  |
| **RAN2#115e** | | |
| * The TRS/CSI-RS configuration is provided in a new SIB. * On demand SI should be possible for the SIB with TRS/CSI-RS information. | Captured in Z.2 |  |
| * RAN2 assumes that TRS/CSI-RS configurations are broadcasted. Potential addition of dedicated signalling can be discussed in a later meeting based on company contributions. | Not yet captured to wait for further progress. |  |
| * The legacy SI update procedure is used for changing TRS/CSI-RS configurations. | No impact by now. |  |
| * Postpone the topic about TRS/CSI-RS availability until a later meeting when RAN1 also has progressed. * Postpone the discussion on segmentation of the new SIB until RAN1 has sent the list of the parameters and a potential structure. * Postpone the discussion on splitting the TRS/CSI-RS information to a common and RS-specific part until RAN1 has sent the list of the parameters and a potential structure. | Not yet captured to wait for further progress. |  |
|  |  |  |
| **RAN2#116e** | | |
| * The scope of the new SIB-X is configurable (either cell or area scope) based on NW implementation. * RAN2 to wait for additional RAN1 feedback, before finalizing aspects on SIB-X sizing, segmentation etc. * RAN2 to wait for further RAN1 input on whether TRS/CSI-RS configuration can be split as common and TRS specific part. * The new SIB-X can be made on demand, and it is up to NW configuration. * There are no UE side impacts due to any additional NW side restriction on on-demand SIB-X. * IDLE/INACTIVE UEs do NOT have to report any feedback on its TRS/CSI-RS resource usage. | No impact |  |
| * RAN2 assumes to support current RAN1 working agreement of L1 based signalling for TRS/CSI-RS availability indication. FFS whether it should be possible to enable / disable the TRS/CSI-RS L1 based availability mechanism by broadcast signalling. | Captured in Z.1 |  |
| * R2 assumes that additional TRS/CSI-RS configuration by dedicated signalling is not supported. Can revisit e.g. based on R1 provided info if needed. * Postpone further discussion on TRS/CSI-RS applicability for eDRX UEs. Can consider later | Not yet captured to wait for further progress. |  |
| **RAN2#116bis-e** | | |
| The number of bits N in the bitmap used for L1 availability indication is derived implicitly from the number of different values of *indBitID*. There is no need for an explicit parameter. | No impact by now |  |
| RAN2 confirm TRS/CSI-RS can be applied to eDRX UEs. | Not yet captured to wait for further progress. |  |
| Confirm that there will be no particular mechanism for availability indication based on SIB (beyond the presence of the RS configuration)  Indicating the TRS/CSI-RS availability in Idle/Inactive when releasing the UE to Idle/Inactive in the *RRCRelease* message is not pursued.  RAN2 follows RAN1 agreement that if TRS resource is configured in SIB, L1 based availability indication is always enabled based on that configuration.  RAN2 waits for RAN1 to finalize the contents of SIB-X before finalizing aspects on SIB-X sizing, segmentation etc | No impact |  |
| P1 is FFS  *Editor’s NOTE: P1 comes from R2-2201918, which is:*  A UE which acquired SIB-X with a TRS/CSI-RS configuration but didn’t yet receive an associated L1-based availability indication considers the configured TRS/CSI-RS as “unavailable”. | Captured in z.2 as an EN to wait for further progress. |  |
|  |  |  |
| **RAN2#117e** | | |
|  |  |  |
|  |  |  |
|  |  |  |

Annex B– RAN1 agreements (only RAN2 relevant part)

### Agreements on paging enhancement

|  |  |  |
| --- | --- | --- |
| **RAN1 agreements** | **Impacted specification** | **Comments, if any** |
| **RAN1#102e** | | |
| N/A |  |  |
| **RAN1#103e** | | |
| N/A |  |  |
| **RAN1#104e and RAN#93e** | | |
| Agreements:  For the evaluation and comparison of PEI candidate designs based on PDCCH, TRS/CSI-RS and SSS, the following are assumed:   * Behv-A:   + PEI indicates UE should monitor a PO if UE’s group/subgroup is paged   + UE is not required to monitor a PO if UE does not detect PEI at all PEI occasion(s) for the PO * Behv-B:   + PEI indicates whether or not UE should monitor a PO   + UE is required to monitor a PO if UE does not detect PEI at all PEI occasion(s) for the PO   Rapporteur: Further conclusion in RAN#93 below should be considered together.   * Support PDCCH-based PEI as the only option   •       Only essential function for PEI is support  •      New DCI format  •      Higher layer configuration, including SS  •      Details of the procedures of PEI monitoring, and identification of MOs before PO  •      Only Behv-A (per RAN1#104e agreement) is supported  •      If TRS availability indication is agreed to be supported in both paging DCI and the DCI format for PEI, same mechanism/principle for TRS availability indication is adopted for the two DCI formats  •      Supporting TRS availability indication in DCI format for PEI shall not delay the completion of essential functionality of PEI | Captured in 7.x.1 |  |
|  |  |  |
| **RAN1#104bis-e** | | |
| N/A |  |  |
| **RAN1#105e** | | |
| For UE subgroups indication in physical layer, maximum of 8 subgroups per PO is supported. | Not yet captured to wait for further progress. |  |
| **RAN1#106e** | | |
| N/A |  |  |
| **RAN1#106bis-e** | | |
| For NR Rel-17, paging indications to UE subgroups are carried only in PEI. | Captured in 7.y.0 |  |
| For PEI, a new DCI format is supported to include at least paging indications to UE group(s)/subgroups of the associated PO(s)   * One bit in the DCI payload indicating one UE subgroup of a PO or one UE group/PO * The maximum number of total bits for paging indication field in PEI DCI format is x   + One PEI can be configured to indicate up to 4 PO(s) in a PF     - FFS whether to supporting map PEI to 3 POs in a PF   + FFS: 1 PEI for POs across multiple PFs   + FFS: value of x | Captured in 7.x.1 |  |
| A PEI occasion (PEI-O) is a set of *S* consecutive PDCCH monitoring occasions when *nrofPDCCH-MonitoringOccasionPerSSB-InPO* is not configured   * *S* is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in SIB1 * The *K*-th PDCCH monitoring occasion for PEI in the PEI-O has the same QCL assumption as that of the *K*-th PDCCH monitoring occasion for paging in the PO.   + Note: QCL reference is SSB * FFS: Determination of the PEI-O location * FFS: Support of unlicensed spectrum operation with *nrofPDCCH-MonitoringOccasionPerSSB-InPO* configured | Captured in 7.x.1 |  |
| Agreement  CORESET # 0 or *commonControlResourceSet* in SIB1 can be used for PEI   * Note: The number of CORESETs configured for a UE follows the requirement of UE feature 3-1   Agreement  Support configuration of a dedicated search space (‘peiSearchSpace’) for PEI   * FFS: Configuration details and whether and how to reuse legacy search space sets, including *pagingSearchSpace* and *searchSpaceSetZero* | Captured in 7.x.1 |  |
| **RAN1#107e** | | |
| Agreement  For unlicensed operation,  A PEI-O is a set of 'S\*X ' consecutive PDCCH monitoring occasions where 'S' is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1* and X is the *nrofPDCCH-MonitoringOccasionPerSSB-InPO* if configured or is equal to 1 otherwise. The [x\*S+K]th PDCCH monitoring occasion for PEI in the PEI-O corresponds to the Kth transmitted SSB, where x=0,1,…,X-1, K=1,2,…,S.   * If X > 1, when the UE detects a PEI within its PEI-O, the UE is not required to monitor the subsequent monitoring occasion(s) associated with the same PEI-O   Note: The QCL reference is SSB | Captured in 7.x.1 |  |
| **Agreement**  Support mapping one PEI to *POnumPerPEI* PO(s) in one or multiple PF(s)          *POnumPerPEI* is a factor of  (total PO number in a paging cycle) and configurable via SIB for the cell with the value range of {1, 2, 4, 8}   * The Maximum number of PF associated with one PEI is up to 2           Note: Maximum number of paging indication bits in DCI format 2\_7 can be kept the same for any configuration of *POnumPerPEI*, e.g., by applying a smaller *subgroupsNumPerPO* and a larger *POnumPerPEI.*          Note: Larger value of *POnumPerPEI* can reduce the average PEI overhead per PO, but there can also cause potentially larger paging latency and larger UE power consumption due to longer UE wake-up time before PO monitoring, which can be significant with large value of (*T/N*). | Partially captured in 7.x.1 |  |
| **Agreement**  Confirm the following working assumption:  **Working Assumption**   * The paging indication field of PEI DCI format comprises of *POnumPerPEI* segment(s) of *K* bit   + *K* = 1, if  is absent or set to 0 or 1,   + *K* = , if  is configured.   + UE identifies its paging indication bit as follows:     - Let  denote the relative PO index, with starting value of 0, among the POs associated with the PEI       * , where  are as defined in clause 7 of TS 38.304     - when *K* = 1 ~~and UE is not provided a subgroup index~~     - when UE is provided a subgroup index     - UE checks the corresponding paging indication from -th bit of the paging indication field where the starting bit index is 0 * If the corresponding paging indication value is set to ‘1’, it indicates the UE to monitor the PO * If the corresponding paging indication value is set to ‘0’, it indicates the UE is not required to monitor the PO | No impact.  Already captured in TS 38.213. |  |
| **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 | No impact. |  |
| **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. | Captured in 7.x.1 |  |
| **Agreement**  The CCE aggregation levels and maximum number of PDCCH candidates per CCE aggregation level for PEI PDCCH monitoring occasion are given as the following table. Actual aggregation levels and PDCCH candidates are provided by ‘peiSearchSpace’ configuration in SIB.   |  |  | | --- | --- | | **CE Aggregation Level** | **Number of Candidates** | | 4 | 4 | | 8 | 2 | | 16 | 1 | | No impact |  |
| **Agreement**  *‘peiSearchSpace’* can be configured to one of up to 4 common SS sets configured by commonSearchSpaceList with *SearchSpaceId*> 0 | Captured in 7.x.1 |  |
| **RAN1#108e** | | |
|  |  |  |
|  |  |  |

### Agreements on TRS/CSI-RS in idle/inactive

|  |  |  |
| --- | --- | --- |
| **RAN1 agreements** | **Impacted specification** | **Comments, if any** |
| **RAN1#104e** | | |
| N/A |  |  |
|  |  |  |
| **RAN1#104bis-e** | | |
| N/A |  |  |
|  |  |  |
| **RAN1#105e** | | |
| Agreement:  Confirm the following working assumption:  Support at least L1 based signaling for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs.   * FFS details, including paging DCI and/or PEI for L1 based signaling * FFS SIB-based signaling/configuration   + Note: It is RAN1 understanding that existing SI update procedure is used for SIB based signalling     Agreement:  For the information provided by a physical layer availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, support availability/unavailability information for configured RS resources using a bitmap or codepoint   * e.g. using bitmap, where each bit is associated with at least one resource/configuration or a set/group of resources * e.g. a codepoint to indicate a state of availability/unavailability for all or some of configured RS resources * FFS maximum number of configured RS resources per physical layer availability indication to support. * FFS whether availability/unavailability information is for all or some of configured RS resources | Captured in Z.1 |  |
| **Working assumption:**  Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.  Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.   * FFS ~~whether and~~ how to enable/disable L1 based availability indication configurable by SIB | Captured in Z.2 |  |
| **RAN1#106e** | | |
| N/A |  |  |
| **RAN1#106bis-e** | | |
| **Agreement**  At least for paging PDCCH based L1 availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, the L1 availability indication is valid for a time duration starting from a reference point, where   * the time duration is a validity duration configured by higher layer,   + FFS applicable values, e.g. # of DRX cycles, or multiple of default paging cycle duration (i.e. modification period)   + FFS UE doesn’t expect inconsistent L1 based indication during the time duration * the reference point for start of the validity duration is one of the following alternatives:   + Alt1: SFN of the first PF from the next DRX cycle   + Alt2: SFN of the first PF from the current DRX cycle where UE receives the indication   + Alt3: based on SFN configured by higher layer, i.e. modification period configured as multiple of default paging cycle duration   + Alt4: start of the PF for the PO where UE receives the indication   + Note: the DRX cycle in Alt1 and Alt2 is the default paging cycle broadcast in SIB   + Note: The SFN for the first PF is ~~for (UE mod N) = 0, and can be~~ calculated by (SFN + PF\_offset) mod T = 0 * the time duration can be optionally configured by gNB   + when the time duration is not configured, one of the following alternatives can be considered:     - Alt1: the availability indication is valid until when the UE receives another availability indication.     - Alt2: the availability indication is valid until L1 availability indication is changed by network     - Alt3: default time duration e.g. default paging cycle * FFS whether and how to handle the miss detection issue of L1 signaling | Partially captured in Z.2 |  |
| **RAN1#107e** | | |
| Agreement  For the maximum number of TRS resource sets configured by higher layer, X,   * X = 64 * FFS: the number of configured TRS resource sets is not larger than the number of actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1 | No impact |  |
| Agreement  For L1 availability indication using a bitmap, the following is supported:   * Number of bits in the bitmap, N, is up to 6 bits * a bit is associated with a group of TRS resource sets. The associated TRS resource sets for each bit can be based on   + explicit configuration of TRS resource set group, where     - each TRS resource set is configured with a ID i, with value from {0, …, N-1}, for the association with an indication bit in TRS availability indication field.     - the ith bit maps to all the TRS resource set(s) associated with ID *i*. * start of the bitmap is the first bit of the reserved bits in paging PDCCH * Note: It is left to RAN2 decision on whether explicit parameter is used for N or it can be implicitly determined by the TRS resource set configurations. | Already captured in TS 38.213.  FFS part is captured |  |
| Agreement  The reference point for start of the validity duration is SFN of the first PF from the current default DRX cycle where UE receives the availability indication   * FFS: Whether the availability indication is transmitted [only once] during the validity duration | Already captured in TS 38.213. |  |
| Agreement  For the validity duration configured by higher layer at least for paging PDCCH based L1 availability indication, support   * time unit is one default paging cycle, * applicable values: {1, 2, 4, 8, 16, 32, [64], [128], [256],[512]}   When the validity duration is not configured, UE assumes a default time duration to be 2 default paging cycle(s). | Partially captured in Z.2 |  |
| Agreement  The following working assumption is confirmed  Working Assumption   * Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs. * Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected. | Already captured in TS 38.213. |  |
| **RAN1#108e** | | |
|  |  |  |
|  |  |  |