3GPP TSG-RAN WG2#123-bis R2-23XXXXX

Xiamen, China, 9 – 13 October, 2023

Agenda Item: x.xx.x

Source: Huawei, HiSilicon

Title: Report of [POST123][312][NES] Running CR 38.331 (Huawei)

Document for: Discussion and decision

# 1 Introduction

This document is the report of the following discussion:

* [POST123][312][NES] Running CR 38.331 (Huawei)

Scope: Review running CR and discuss issue configuration per serving cell or MAC entity

Outcome: CR to be submitted to next meeting

Deadline: long

The intention of this discussion is to provide a running RRC CR for NES and discuss the issue of cell DTX/DRX configuration per serving cell or MAC entity.

 **Please provide your comments by: Friday September 22nd, 2023, 1000 UTC**

Companies providing input to this email discussion are requested to leave contact information below.

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# 2 Discussion on the per serving cell or MAC entity configuration issue

During the RAN2#123 meeting it was discussed whether Cell DTX/DRX configuration status is per MAC entity or per Serving Cell, which has implications on the 38.331 and 38.321 specifications [3]. The main impact of these configuration options is for UEs operating in CA, which have more than one serving cell. RAN1 has already agreed that the activation/deactivation is per serving cell, which was also confirmed by RAN2.The only remaining issue is what is the granularity of the configuration.

There was a following SI phase agreement:

5 Cell DTX/DRX can be configured per serving cell and can be applicable for different cells in CA. No additional RAN2 impacts or enhancements are foreseen.

And we also have a WI phase agreement:

1. Pattern configuration for cell DRX/DTX is common for Rel-18 UEs in the cell.

In the per MAC entity option, which is similar to how C-DRX is configured, all serving cells of a UE should have the same cell DTX/DRX parameters to align with the one C-DRX configuration. In this option the activation status, which is set on a per cell basis, would need signalling which conveys also information to which of the serving cells the activation/deactivation status applies. This mode is simpler from the UE implementation perspective but has limitations in the NW configuration and it may be difficult to apply separate activation status across serving cells.

For the per serving cell option, different serving cells can have different cell DTX/DRX parameters. This brings flexibility of NW implementation but complexity of UE implementation, which would need to maintain separate cell DTX/DRX configurations for each of its serving cells in CA. In this scenario it would be easier to convey the activation status as the configuration would be per cell and each serving cell could have a different cell DTX/DRX state.

In your answer please also highlight the issues that will arise if the other option is chosen, e.g. UE complexity for per cell configuration or difficult NW configuration for per MAC entity, etc.

**Question 1:** *Do you prefer Cell DTX/DRX configuration to be per MAC entity or per Serving Cell?*

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| --- | --- | --- |
| **Company** | **Answer** | **Comments** |
| Vodafone | Not 100% sure | I feel (a bit different from my previous opinion) that it is more important that UE has an aligned configuration across the serving cells. What would be the motivation to have a possibility to provide the UE different configurations for different serving cells? On activation aspects, please see my comments below.  |
| Xiaomi  |  | This issue was discussed in last RAN2 meeting and no consensus at last. We prefer per MAC entity option. * + In RAN1 discussion, two cell can share the same bit location in DCI, i.e., the cell DRX/DTX configuration can be same/common for the two cell, e.g., cell ¾.

So, it is possible to configure cell DRX/DTX in a cell group. If it is hard to decide the cell DTX/DRX in UE side is per MAC entity or per serving cell. We can compromise to cell group-based cell DRX/DTX configuration in UE side for progress.  |
| Samsung | Per cell | We prefer per cell option for flexibility and to align with agreements made based on per cell configuration and activation. Also, considering non-collocated (inter-site) CA scenarios, it would be reasonable to have per cell configuration. |
| vivo | per MAC entity | Since legacy C-DRX is per MAC entity, and there are new NW/UE behaviors defined for cell DTX/DRX non-active period, making Cell DTX/DRX config. per MAC entity is much easier for UE implementation. We do not observe the need of providing flexibility for the NW to configure different cell DTX/DRX patterns for the serving cells, and thus prefer the configuration to be per MAC entity. |
| ZTE | Per cell | The cell DTX/DRX functionality controls the reception of PDCCH and SPS, and the transmission of SR and CG. And the resource configuration of SPS, SR and CG is per cell. If the cell DTX/DRX is per MAC entity, it is hard for gNB to coordinate those resource in each Scell and Pcell. Hence, in sake of the flexibility in gNB, we suggest Cell DTX/DRX configuration to be per cell. |
| Qualcomm | MAC Entity | Cell DTX/DRX from an implementation standpoint would be implemented on top of UE C-DRX (which is per-mac entity except for a few parameters that are per C-DRX configuration with a maximum of two configurations). Thus, per MAC entity would be the straightforward extension. Concerns with per-serving cell are as follows:* Completely changes PDCCH decoding from the previous releases into per-carrier PDCCH decoding, which is a very big change to current implementations, since the UE would need to track up to 8 different “effective ON durations” to track separate intersections & cycles of different cells with UE C-DRX ON duration. This complicates blind decoding a lot and opens up new issues regarding cross-carrier scheduling. This would also be very wasteful of UE power and complicates the feature needlessly.
* RAN1 has agreed that “UE monitor DCI format 2\_X in one serving cell”, so the configurations, we assume, would be already limited to having similar periodicity and start offsets, since it doesn’t make sense for one cell to (de)activate another cell in the middle of non-active cycle, so coordination and tight coupling is already needed. I
* Motivation: The target motivation of cell DTX/DRX is a cell with 10-30% utilization to save energy over time. It is not clear why a UE would connect to 2-8 cells each running their own Cell DTX/DRX algorithm, i.e., each having 10-30% utilization. To us, this is not a realistic deployment at all. One deployment that came up in the discussion is a capacity-boosting Scell that is not fully utilized with a fully utilized Pcell, at which case, the Cell DTX/DRX can be activated for this Scell alone. We do not see why Pcell and Scell or different Scells would run their own misaligned patterns.
* SI agreement was made with full alignment assumption, at which case, it was less messy since the ON duration itself was guaranteed a clean pattern of PDCCH occasions. Now RAN2 has moved from full alignment to partial alignment, thus, messy configuration options that don’t have technical benefits should be avoided.
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| CEWiT | Per Cell | We prefer per cell to align with the SI agreement. Also, the L1 signalling for activation/deactivation, agreed in RAN2, is per cell which will further support the feasibility of per cell configuration.Concerns for per MAC entity: The NES technique is applicable when the load is low or medium in a cell. Thus the per mac entity DTX/DRX configuration which is common for different cells cannot handle the varying load across cells, thereby reducing the effectiveness of the technique. |
| Apple | per MAC entity | First, we fully agree with raised 4 technique concerns from QC. Suggest Proponents of per serving cell address these concerns one by one. Secondly, according to current RRC spec, up to 16 serving cells can be configured for one cell group. **Thus, if per serving cell, the UE needs to run up to 32 parallel Cell DTX patterns and up to 32 parallel Cell DTX patterns (64 patterns and corresponding 64 state machines in total).** We will be curious which UE vendors can implement such a complex feature. At least, the max number of parallel Cell DTX/DRX pattern should be restricted.  |
| Nokia | Per Cell | Agree with Samsung and ZTE. |
| Fujitsu | Per Cell | Agree with Samsung and ZTE.For a compleixy, RAN2 has already agreed alignment between Cell DTX/DRX and C-DRX on-duration is ensured by network. Therefore, in CA, the network should also select CCs with similar Cell DTX/DRX pattern for avoiding UE impacts.  |
| Sharp | Per Cell | Agree with Samsung and ZTE. |
| Ericsson | Per Cell or at least one for PCell and one for SCells  | In terms of complexity, we understand that one pattern for Pcell and one for Scells is similar complexity as the UE has today for UE DRX when both MCG and SCG are configured, i.e. in both cases only 2 different patterns are configured. |
| OPPO | Per Cell | Although per-MAC entity cell DTX/DRX configuration may simplify the UE behaviour, e.g. the UE only needs to maintain one set of cell DTX/DRX configurations for all serving cells, it may not much reasonable, since 1) it is hard for the gNB to allocate resources and coordinate with others because individual UEs which have their own traffic characteristics would only have partially overlapped serving cells. 2) The UE anyway needs to maintain cell DTX/DRX per serving cell because there would be cases in which part of the UE’s serving cells are activated.  |
| InterDigital | Per MAC entity | PDCCH is monitored per C-DRX anyway, which is configured per MAC entity/DRX group. Agree with the points raised by QC.  |

*[Rapporteur’s summary and proposals]*

# 3 Running RRC CR for NES

The running RRC CR for NES is provided in the discussion folder. Small comments can be added as bubble comments in the draft CR, please don’t change the CR text. If more detailed suggestions on procedures or wording changes are proposed please use the table below to highlight them for clarity of the CR tdoc.

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| --- | --- | --- |
| **Company** | **Detailed comments** | **Rapporteur response** |
| Vodafone | As per agreement we made before, it is already captured that:The IE *CellDTX-Config* is used to configure cell DTX related parameters. **Cell DTX is activated implicitly once configured by the network.**Now, once L1 activation is agreed as activation procedure, we need to define how these 2 ways of activations are interworking.According to the current stage, it seems to me that there is no room for L1 activation procedure as provided configuration is always activated once received. If we want to utilize L1 procedure, we need to have a bit in the configuration saying that it is configuration only and the activation will be triggered by L1. Following we would also need to discuss deactivation procedure. Please indicate if you agree with my statement.Minor comment: We agreed Activation/deactivation is per serving cell. FFS if the configuration is per cell or per MAC entity, but looking into:*MAC-CellGroupConfig*The IE *MAC-CellGroupConfig* is used to configure MAC parameters for a cell group, including DRX and cell DTX/DRX.Editor’s note: FFS whether the Cell DTX/DRX configuration and activation is per MAC entity or per serving cell. |  |
| Xiaomi  | – *MAC-CellGroupConfig*The IE *MAC-CellGroupConfig* is used to configure MAC parameters for a cell group, including DRX and cell DTX/DRX.Editor’s note: FFS whether the Cell DTX/DRX configuration and activation is per MAC entity or per serving cell.1. RAN2 agreed that cell DTX/DRX A/D is per serving cell, FFS for cell DRX/DTX configuration.
2. RAN2 did not conclude the case for dual UE C-DRX, maybe two cell DTX/DRX are configured for FR1 and FR2 respectively. We also need a FFS for it.
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| Samsung | (1) Description of ‘*cellBarred* under *MIB’*

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| *MIB* field descriptions |
| ***cellBarred***Value *barred* means that the cell is barred, as defined in TS 38.304 [20]. This field is ignored by IAB-MT. This field is ignored for connectivity to NTN. |

- We need to specify that NES capable UE shall ignore the below barring field in MIB, similar to IAB and NTN.Suggestion> to add ‘This field is ignored by NES capable UE, (if *cellBarredNES* is configured in SIB1)’(2) Description of ‘*cellBarred* under *SIB1*

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| *SIB1* field descriptions |
| ***cellBarredNES***Value *barred* means that the cell is barred for a NES-capable UE, as defined in TS 38.304 [20]. Value *notBarred* means that the cell is allowed for NES-capable UEs. If not present, the NES-capable UEs shall follow the MIB *cellBarred* indication. This field is ignored by non-NES-capable UEs. |

- it is obvious that a non-NES-capable UE would ignore this field. Also, we would like to avoid discussing the definition of ‘non-NES-capable UE’.Suggestion> to modify ‘This field is only applicable to NES-capable UEs’(3) Description of ‘*jointCellDTXDRXconfig* under *CellDTX-Config*

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| *CellDTX-Config* field descriptions |
| ***jointCellDTXDRXconfig***If set to true, the UE shall also apply a cell DRX configuration with the same parameters as in CellDTX-Config.  |

- May cause a confusion if a network configures different parameters for DTX and DRX, and also set this field true. We think it would be simpler just to have an indicator that indicates those two configurations are the same.Suggestion> to modify as an indicator which informs that the cell DTX and DRX patterns are the same.(4) MAC-CellGroupConfig– *MAC-CellGroupConfig*The IE *MAC-CellGroupConfig* is used to configure MAC parameters for a cell group, including DRX and cell DTX/DRX.Editor’s note: FFS whether the Cell DTX/DRX configuration and activation is per MAC entity or per serving cell.- Our understanding is that *cellDTX-Config* may be relocated to *ServingCellConfig*, depending on per cell vs per cell group configuration.However, if companies have the same understanding, it’s fine for now. |  |
| vivo | (1) FD of ***jointCellDTXDRXconfig:***According to R2#123 agreement: On-duration and Cycle parameters are common between cell DTX and DRX, when both are configuredWe understand this is mandatory, and thus the field should not be optional. Otherwise, the absence of it means On-duration and Cycle parameters between cell DTX and DRX can be different, which is **not** aligned with R2 agreement.1. For cell bar for NES-capable UE:

According to the current running 331 CR, the NES-capable UE only needs to read *cellBarredNES* in SIB1 when the *cellBarred* in the acquired *MIB* is set to *barred*. Then, the NES-capable UE needs to check in SIB1 whether it is allowed to camp. From our understanding, the easiest way is to use only one codepoint for *cellBarredNES* in SIB1, i.e., cellBarredNES-r18 ENUMERATED {true} OPTIONAL, -- Need RWhen *cellBarredNES* is not present in SIB1, the NES-capable UE will consider the cell as barred.  |  |
| ZTE | 1. The field description of celldrx-onDurationTimer,

According to the agreement “*On-duration and Cycle parameters are common between cell DTX and DRX, when both are configured. FFS if we have different start offset configuration for cell DTX and cell DRX*”, in order to save the signaling overhead, we suggest to configure only celldtx-onDurationTimer when both of CellDRX-Config and CellDTX-Config is configured. In a word, if celldrx-onDurationTimer is absent, the value of celldrx-onDurationTimer is same as the value of celldtx-onDurationTimer. Hence, we suggest to modify the description as below:***celldrx-onDurationTimer***Value in multiples of 1/32 ms (subMilliSeconds) or in ms (milliSecond). For the latter, value *ms1* corresponds to 1 ms, value *ms2* corresponds to 2 ms, and so on. If this field is absent, the value of celldrx-onDurationTimer is same as the value of celldtx-onDurationTimer when both of CellDRX-Config and CellDTX-Config are configured.1. The field description of *cellBarredNES* seems not consistent with our understanding, because NES-capable UE may support other features. e.g. If a NES-capable UE is also a redCap UE, even if cellBarredNES is not present, the UE should further follow the cellBarredRedCap1Rx, cellBarredRedCap2Rx etc.

For RedCap UE, the existing principle is that RedCap UE would consider the cell as barred if any of the cellbarred in MIB, cellBarredRedCap1Rx, cellBarredRedCap2Rx in SIB1 is set to barred.And we understand the same principle also applies when the *cellBarredNES* is introduced and the expected interpretation for the following setting would be as follows (this is a screenshot while the table is copied at the end of this document) :Which means, for NES-capable UE, only the *cellBarred* in MIB can be ignored, NES-capable UE still need to check other cell bar indication for other features, e.g. RedCap, if it is also a RedCap UE.To achieve the above understanding, we propose the following change in 331:

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| ***cellBarredNES***Value *barred* means that the cell is barred for a NES-capable UE, as defined in TS 38.304 [20]. Value *notBarred* means that the cell is allowed for NES-capable UEs. If ~~not~~ present, the NES-capable UEs shall ~~follow~~ ignore the MIB *cellBarred* indication. This field is ignored by non-NES-capable UEs. |

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| Qualcomm | We should modify Cell DTX as follows.***celldtx-CycleStartOffset****celldtx-Cycle* in ms and *celldrx-StartOffset* in multiples of 1 ms. *celldtx-Cycle* is an integer multiple of drx-longCycle or vice versa. We want to incorporate this last meeting agreement: “Understanding is that alignment means that the cell DTX/DRX and C-DRX periodicity should be multiple of each other” As clarified in alignment agreement, this is not a free value. It is tightly coupled to C-DRX cycle value. As we mentioned in the meeting, the importance of that is that UE implementation needs the assumption of consistent PDCCH occasions between cycle; this would be the difference between a straightforward implementation that obtains a clean ON duration with a constant “effective ON duration” (now derived as an intersection between C-DRX ON duration and Cell DTX active time”) and a cycle-by-cycle varying effective ON duration. The field values also must be defined as multiples of UE C-DRX long cycle values and not free “ms” values to avoid erroneous configurations that misalign cycles.  |  |
| CEWiT | (1) MAC-CellGroupConfig– *MAC-CellGroupConfig*The IE *MAC-CellGroupConfig* is used to configure MAC parameters for a cell group, including DRX and cell DTX/DRX.Editor’s note: FFS whether the Cell DTX/DRX configuration and activation is per MAC entity or per serving cell.- We think that the *cellDTX-Config* can be relocated to *ServingCellConfig*, based on per cell configuration. |  |
| Apple | 1) On field description of ‘*cellBarred* under *SIB1,* we agree with Samsung that it is better to avoiddiscussing the definition of ‘non-NES-capable UE’. Thus, we agree with their suggested change:*"*This field is ignored by non-NES-capable UEs." -> to modify ‘This field is only applicable to NES-capable UEs’.2) We see multiple suggestions/comments to simplify *cellDTX-Config* and *cellDRX-Config.* We share some sympathy and think the IE structure can be simplified in below way: * Introduce one separate IE (e.g. *cellDTXDRX-commonParameters*) for common parameters of Cell DTX and Cell DRX (at least including agreed On-duration and Cycle parameters, and potential offset if agreed in upcoming meeting).
* Introduce a top level IE *CellDTXDRX-Config* which includes the common parameter IE for On-duration and Cycle parameters and a ENUMERATED IE to select among jointDTX/DRX, or onlyDTX or only DRX (as agreed in last RAN2 meeting).

 For example:*CellDTXDRX-Config* information element-- ASN1START-- TAG-CELLDTXDRX-CONFIG-STARTCellDTXDRX-Config-r18 ::= SEQUENCE { cellDTXDRX-commonParameters-r18 cellDTXDRX-commonParameters-r18,  CellDTXDRX-mode-r18 ENUMERATED {jointCellDTXDRX, onlyCellDTX, onlyCellDRX} }CellDTXDRX-commonParameters-r18 ::= SEQUENCE { celldtxdrx-onDurationTimer-r18 CHOICE { subMilliSeconds INTEGER (1..31), milliSeconds ENUMERATED { ms1, ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30, ms40, ms50, ms60, ms80, ms100, ms200, ms300, ms400, ms500, ms600, ms800, ms1000, ms1200, ms1600, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 } } OPTIONAL, -- Need M  celldtxdrx-CycleStartOffset-r18 CHOICE { ms10 INTEGER(0..9), ms20 INTEGER(0..19), ms32 INTEGER(0..31), ms40 INTEGER(0..39), ms60 INTEGER(0..59), ms64 INTEGER(0..63), ms70 INTEGER(0..69), ms80 INTEGER(0..79), ms128 INTEGER(0..127), ms160 INTEGER(0..159), ms256 INTEGER(0..255), ms320 INTEGER(0..319), ms512 INTEGER(0..511), ms640 INTEGER(0..639), ms1024 INTEGER(0..1023), ms1280 INTEGER(0..1279), ms2048 INTEGER(0..2047), ms2560 INTEGER(0..2559), ms5120 INTEGER(0..5119), ms10240 INTEGER(0..10239) } OPTIONAL, -- Need M celldtxdrx-SlotOffset-r18 INTEGER (0..31) }-- TAG-CELLDTXDRX-CONFIG-STOP-- ASN1STOP |  |
| Nokia | “NES capable” is fine for this CR (also mentioned in 38.304 that we should have similar FFS as you have in this CR regarding “what NES-capable means”. I would guess we would just refer to appropriate UE capability once we have those.Regarding barring, you should add that NES-capable ignores legacy *cellBarred* if *cellBarredNES* is present. Otherwise legacy barring will bar the cell although intention is to allow NES capable UE to camp on that if new barring is present and indicating notBarred.Regarding NES CHO – I think we could already based on the agreements capture how to model the CHO even if we don’t have actual NES trigger yet. Simplest seems to have a extensions for existing events (see R2-2307766). If you have better idea how to configure feel free to capture those as a rapporteur. And then in CHO procedural text (5.3.5.13.4 Conditional reconfiguration evaluation) we would just have two separate bullets for “if the condEventId is associated with condEventA3, condEventA4 or condEventA5” – one with NES and one without NES (existing “legacy” one) i.e. new condition would be only fulfilled if also “NES CHO” indication is given to the UE. Agree to introduce explicit indication of activation or deactivation upon configuration of Cell DTX/DRX now that we have introduced L1 signalling on top. It could be leave to NW implementation to configure it as activated or deactivated upon configuration. |  |
| Sharp | For *cellBarredNES* in SIB1, open to further discuss NES+RedCap UE. But for the last row in the table, we think NES+RedCap UE should follow *cellBarred* in MIB as RedCap UE. Then seems the current description in running CR has covered this case. |  |
| Ericsson | 1. On cellBarredNES*:*
	1. We agree with Samsung’s suggestion on changing "This field is ignored by non-NES-capable UEs." to “This field is only applicable to NES-capable UEs”, since this would simplify the wording;
	2. Also agree with ZTE that field description should say “If not present, the NES-capable UEs shall ignore the MIB cellBarred indication”. In fact, we understand that the intention with barring is only to prevent legacy UEs from accessing the cell, so additionally, we should also change the cellBarred field to ENUMERATED {true} and only include it when the NW does want NES-capable UEs to access the cell while barring legacy ones.
2. On cellDTXDRX:
	1. All fields seem to be optional now for cell DTX/DRX configuration, while for UE C-DRX only short DRX is optional – we do not see a need to deviate from the previous structure, this is already wrapped in SetupRelease which allows delta configuration on the IE level; there is no need to have optional fields therein, we can just have them mandatory as for the UE C-DRX structure;
	2. We also agree with Apple’s suggestion to include a single IE that includes common fields. But we may not need ENUMERATED {jointCellDTXDRX, onlyCellDTX, onlyCellDRX}, and can rely on different offsets for DTX and DRX – e.g. if the offset for DTX is present, the configuration is applied to DTX, if the offset for DRX is present, the configuration is applied to DRX.
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| OPPO | 1. Similar view as the above companies, that 1) it is already agreed that the activation of cell DTX/DRX is per cell, the FFS part is only for the configuration of cell DTX/DRX. 2) if the per-cell configuration is eventually agreed, MAC-CellGroupConfig will not be a suitable father IE to include cell DTX/DRX config.

– MAC-CellGroupConfigThe IE MAC-CellGroupConfig is used to configure MAC parameters for a cell group, including DRX and cell DTX/DRX.Editor’s note: FFS whether the Cell DTX/DRX configuration and activation is per MAC entity or per serving cell.1. On “cellBarredNES”, we agree with companies to use "This field is only applicable to NES-capable UEs" instead of "This field is ignored by non-NES-capable UEs.", to avoid discussing the definition of ‘non-NES-capable UE’ as well as align with TS 38.304.

BTW, we do not agree with the addition of “NES-capable ignores legacy cellBarred if cellBarredNES is present”， since RAN2 has not achieved such an agreement till now.1. On whether to have an explicit indication to use the L1 signalling-based cell DTX/DRX activation/deactivation mechanism, we think further discussion is needed in RAN2, since the implicit indication can also be considered.
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| Cell barred in MIB | Cell barred for RedCap | Legacy UE (except RedCap UE ) | RedCap UE | Cell barred NES | NES UE | NES + RedCap UE |
| barred | barred | Access not allowed  | Access not allowed | barred | Access not allowed | Access not allowed |
| Not barred | Access allowed | Access not allowed |
| barred  | Not barred | Access not allowed | Access not allowed | barred | Access not allowed | Access not allowed |
| Not barred | Access allowed | Access allowed |

# 4 Conclusion

Based on the discussion in the previous sections we propose the following:

**Proposal 1** abc

**Proposal 2** def

# 5 References

1. RP-223540, “New WID: Network energy savings for NR”, Huawei
2. 3GPP TR 38.864 V1.0.0, “Study on network energy savings for NR (Release 18)”
3. R2-2308963, “Report from Session on NES, UAV, Rel-15-17 UP, Rel-17 Small Data, IIoT/URLLC, and RACH partitioning”, Session Chair (InterDigital)