3GPP TSG-RAN WG2 Meeting #116bis Electronic [R2-220xxxx](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-220xxxx.zip)

Elbonia, 17 – 25 January 2022

**Agenda item: 8.17.2**

**Source: Nokia (Rapporteur)**

**Title: Report of [AT116bis-e][059][feMIMO] Specific items: SI, MPE (Nokia)**

**WID/SID: NR\_FeMIMO-Core - Release 17**

**Document for: Discussion and Decision**

# 1 Introduction

This document is the report of the following email discussion:

* [AT116bis-e][059][feMIMO] Specific items: SI, MPE (Nokia)

      Scope: Take into account [R2-2201275](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201275.zip), [R2-2200569](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200569.zip), [R2-2201058](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201058.zip), collect comments, for SI: Identify options, if possible - find agreements to converge / limit the options. For MPE progress if possible.

      Intended outcome: Report

The following topics are covered under this email discussion:

* **PHR reporting with MPE (**[**R2-2201058**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201058.zip)**):** Is the RRC configuration proposed in according to latest RAN1 input? For MAC CEs, how is MPE information reported (e.g. number of bits per beam information, impacts to PHR format)? Is the same MAC CE design applicable for all PHR formats (single-entry, multi-entry with max 8 cells and multi-entry with max 32 cells)?
* **PHR reporting with mTRP (e.g.** [**R2-2201058**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201058.zip)**, also covered by 8.17.3 Tdoc summary in** [**R2-2201699**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201699.zip)**):** Can we just duplicate the existing per-cell PH entries for mTRP cells, or is something else needed? Can we use MPE with mTRP (this likely needs verification from RAN1, so we may need to discuss if we put this as question for an LS to RAN1, which I believe we will anyway make for the ICBM cases)
* **SI handling:** Can we reuse dedicated signalling for SI provisioning (as proposed in e.g. [R2-2200569](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200569.zip))? How to handled short message reception (discussed in [R2-2201275](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201275.zip) and P5 of [R2-2201098](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201098.zip))?
* **General:** Do we need to create new MAC CEs (i.e. format with different LCID) for any of the cases? How are the MPE and mTRP information combined (if that is allowed)?

# 2 Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Name | Email Address |
| Nokia (Rapporteur) | Tero Henttonen | tero.henttonen@nokia.com |
| OPPO | ZhongdaDu | duzhongda@oppo.com |
| vivo | Chenli | Chenli5g@vivo.com |
| Ericsson | Helka-Liina Määttänen | Helka-liina.maattanen@ericsson.com |
| Huawei, HiSilicon | David Lecompte | david.lecompte@huawei.com |
| Apple | Fangli XU | fangli\_xu@apple.com |
| Qualcomm | Ozcan Ozturk | oozturk@qti.qualcomm.com |
| Samsung | Seungri Jin | seungri.jin@samsung.com |
| CATT | Erlin Zeng | erlin.zeng@catt.cn |
| Fujitsu | Meiyi Jia | jiameiyi@fujitsu.com |
| LGE | Hanul Lee | hanul.lee@lge.com |
|  |  |  |
|  |  |  |

# 3 Discussion

## 3.1 PHR reporting with MPE: RRC

For the PHR reporting including MPE information, RAN1 has indicated(in [R2-2200095](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200095.zip)) the following (UE-specific) L1 parameters (which also partly explain the intent in the "comment"-column):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **WI code** | **Parameter name in the spec** | **Description** | **Value range** | **Per (UE, cell, TRP, …)** | **Comment** |
| NR\_feMIMO-Core | mpe-Reporting-FR2-r17 | Indicates whether the UE shall report Rel17 MPE P-MPR in the PHR MAC control element, as specified in TS 38.321 [3] - This can be in PHR-Config (up to RAN2) 0=no P-MPR report 1=P-MPR report | {0, 1} | Per UE per cell per BWP  in [PHR-Config] | It can be discussed in RAN2 whether a new parameter/structutre is needed or the associated legacy parameter/structure for PHR reporting can be directly reused |
| NR\_feMIMO-Core | MPE-Config-FR2-r17 | This can be in PHR-Config (up to RAN2), including timer, threshold, and N |  | Per UE per cell per BWP  in [PHR-Config] | It can be discussed in RAN2 whether a new parameter/structutre is needed or the associated legacy parameter/structure for PHR reporting can be directly reused |
| NR\_feMIMO-Core | mpe-ProhibitTimer-r17 | Value in number of subframes for MPE reporting, as specified in TS 38.321 [3]. Value sf10 corresponds to 10 subframes, and so on. This can be in PHR-Config (up to RAN2) | sf0, sf10, sf20, sf50, sf100, sf200, sf500, sf1000 | Per UE per cell per BWP  in [PHR-Config] | It can be discussed in RAN2 whether a new parameter/structutre is needed or the associated legacy parameter/structure for PHR reporting can be directly reused |
| NR\_feMIMO-Core | mpe-Threshold-r17 | Value of the P-MPR threshold in dB for reporting MPE P-MPR when FR2 is configured, as specified in TS 38.321 [3]. The same value applies for each serving cell (although the associated functionality is performed independently for each cell). This can be in PHR-Config (up to RAN2) | dB3, dB6, dB9, dB12 | Per UE per cell per BWP  in [PHR-Config] | It can be discussed n RAN2 whether a new parameter/structutre is needed or the associated legacy parameter/structure for PHR reporting can be directly reused |
| NR\_feMIMO-Core | numberOfN | Number of reported P-MPR values  In addition to the existing field in the PHR MAC-CE, N≥1 P-MPR values can be reported P-MPRs. This can be in PHR-Config (up to RAN2) | {1,2,3,4} | Per UE per cell per BWP  in [PHR-Config] | It can be discussed in RAN2 whether a new structutre is needed or not. If not, this parameter may be included as a new Rel-17 parameter in the legacy PHR IE structure |
| NR\_feMIMO-Core | mpe-ResourcePool | SSB/CSI-RS resource pool for P-MPR reporting | TBD | Per UE per cell per BWP | Detailed design (location, etc.) is up to RAN2  Applies only to Rel-17 unified TCI Framework |

**Table 1. L1 parameters for Rel-17 MPE reporting**

The RAN1 intent seems to be that when unified TCI is used, UE may be monitoring multiple beams, some of which may be required to use MPE backoff and some don't. Since network also knows which beams it can use for UE transmissions, it can request UE to report additional MPE information (*mpe-ReportingFR2-r17*) and also limit what UE can report to only those beams (*mpe-ResourcePool*). When UE reports PHR, it can indicate 0-4 (*numberOfN*) "additional" beams that it considers suitable for UL transmission, and which may have different amount of P-MPR (due to different MPE situation) than the current UL beam.

This then allows network to decide whether to use different UL beam for the UE (e.g. current beam has high P-MPR but another reported beam doesn't, so it makes sense for the network to switch the UL beam). Additionally, RAN1 has indicated that the same parameters as for Rel-16 MPE reporting can be included, but left it up to RAN2 as to whether to duplicate those parameters or not.

Obviously, this requires changes to both RRC (configuration) and MAC (MAC CE for PHR reporting with the MPE information). The running RRC CR (in [R2-2201560](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201560.zip)) has already provided a "baseline" proposal for the MPE configuration according to above, so RAN2 can first discuss if that proposal is sufficient for RRC configuration.

**NOTE:** The MPE resource pool has been left undefined in the CR (since the number of elements was not yet agreed in RAN1), so comments on that can also be provided in the below feedback forms.

### **Question 1a**: Are any changes required to the MPE RRC configuration compared to the version provided in [R2-2201560](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201560.zip)?

|  |  |  |
| --- | --- | --- |
| Answers to Question 1 | | |
| Company | Yes/No | Technical Arguments |
| OPPO | No |  |
| Vivo | No |  |
| Ericsson | Yes | Resource pool is not known now.  Last meeting RAN2 conlcusion/agreement was:  4: Rel-17 MPE configuration can be included in PHR-Config. Will ask R1 whether MPE information can apply to both ICBM and mTRP  However, the question about BWP can be added to the RRC parameter LS together with the pool size. |
| Huawei, HiSilicon | Maybe | The configuration is fully at cell group level while RAN1 has written per cell per BWP everywhere. So we should confirm e.g.  - whether the threshold/numberOfN can be different for different cells or different BWPs  - whether the candidate resources can be different for different BWPs |
| Nokia, Nokia Shanghai Bell | Yes | Agree with Huawei it would be good to understand the BWP-aspects.  Additionally, the mpe-ResourcePool is not yet defined uin the CR. We provided an example of the configuration in R2-2201058 as starting point. |
| Intel | Yes | RAN1 indicated in RRC parameter list that all parameters (mMPE-Config-FR2-r17, , mpe-ProhibitTimer-r17, mpe-Threshold-r17, numberOfN, mpe-ResourcePool) are per UE per cell per BWP although they also indicated all parameters (except mpe-ResourcePool) is in [PHR-Config]. It seems reasonable to have these parameters per BWP. |
| Apple | Yes | Agree with Huawei, RAN1 list all the MPE parameters in the granularity of Per UE per cell per BWP. So we should first confirm where to place the new MPE parameters. |
| Qualcomm | Yes | Agree with others that this should be per BWP |
| ZTE | Yes | Agree with HW, the granularity RAN1 list is really confusing to us. |
| Samsung | Yes | Agree with HW. |
| CATT | Yes | Agree with Huawei, we need to confirm first the granularity of these MPE parameters from RAN1. |
| Fujitsu | Yes | Agree with HW, these parameters should be configured per BWP. |
| LGE | Yes | Agree with HW. |

**Summary 1a**: TBD.

**Proposal 1a**: TBD.

### **Question 1b**: If you replied "yes" to Q1a, please provide proposed RRC changes (including both ASN.1 and required field/condition descriptions) in below table (with highlighting).

|  |  |
| --- | --- |
| Company | ASN.1 example |
| Rapporteur (Baseline RRC CR) | ASN.1 in [R2-2201560](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201560.zip) (highlighting showing RRC CR rapporteur proposal):  -- ASN1START  -- TAG-PHR-CONFIG-START  PHR-Config ::= SEQUENCE {  phr-PeriodicTimer ENUMERATED {sf10, sf20, sf50, sf100, sf200,sf500, sf1000, infinity},  phr-ProhibitTimer ENUMERATED {sf0, sf10, sf20, sf50, sf100,sf200, sf500, sf1000},  phr-Tx-PowerFactorChange ENUMERATED {dB1, dB3, dB6, infinity},  multiplePHR BOOLEAN,  dummy BOOLEAN,  phr-Type2OtherCell BOOLEAN,  phr-ModeOtherCG ENUMERATED {real, virtual},  ...,  [[  mpe-Reporting-FR2-r16 SetupRelease { MPE-Config-FR2-r16 } OPTIONAL -- Need M  ]],  [[  mpe-Reporting-FR2-r17 SetupRelease { MPE-Config-FR2-r17 } OPTIONAL, -- Need M  twoPHRMode-r17 ENUMERATED {enabled} OPTIONAL -- Need R  ]]  }  MPE-Config-FR2-r16 ::= SEQUENCE {  mpe-ProhibitTimer-r16 ENUMERATED {sf0, sf10, sf20, sf50, sf100, sf200, sf500, sf1000},  mpe-Threshold-r16 ENUMERATED {dB3, dB6, dB9, dB12}  }  MPE-Config-FR2-r17 ::= SEQUENCE {  mpe-ProhibitTimer-r17 ENUMERATED {sf0, sf10, sf20, sf50, sf100, sf200, sf500, sf1000},  mpe-Threshold-r17 ENUMERATED {dB3, dB6, dB9, dB12},  numberOfN-r17 INTEGER{1..4},  mpe-ResourcePool-r17 FFS  }  --Editor’s note: mpeResourcePool should contain SSB/CSI-RS resource pool for P-MPR reporting but value range is TBD.  -- TAG-PHR-CONFIG-STOP  -- ASN1STOP |
| Ericsson | The FFS on pools need to be sorted |
| Huawei, HiSilicon | Anything that needs to be per serving cell or per BWP needs to be moved there (see our answer to previous question) |
| Nokia, Nokia Shanghai Bell | PHR-Config ::= SEQUENCE {  phr-PeriodicTimer ENUMERATED {sf10, sf20, sf50, sf100, sf200,sf500, sf1000, infinity},  phr-ProhibitTimer ENUMERATED {sf0, sf10, sf20, sf50, sf100,sf200, sf500, sf1000},  phr-Tx-PowerFactorChange ENUMERATED {dB1, dB3, dB6, infinity},  multiplePHR BOOLEAN,  dummy BOOLEAN,  phr-Type2OtherCell BOOLEAN,  phr-ModeOtherCG ENUMERATED {real, virtual},  ...,  [[  mpe-Reporting-FR2-r16 SetupRelease { MPE-Config-FR2-r16 } OPTIONAL -- Need M  ]],  [[  mpe-Reporting-FR2-r17 SetupRelease { MPE-Config-FR2-r17 } OPTIONAL -- Need M  ]]  }  MPE-Config-FR2-r16 ::= SEQUENCE {  mpe-ProhibitTimer-r16 ENUMERATED {sf0, sf10, sf20, sf50, sf100, sf200, sf500, sf1000},  mpe-Threshold-r16 ENUMERATED {dB3, dB6, dB9, dB12}  }  MPE-Config-FR2-r17 ::= SEQUENCE {  mpe-ServingCellConfig-r17 MPE-ServingCellConfig-r17  ...  }  MPE-ServingCellConfig-r17 ::= SEQUENCE {  servCellIndex-r17 ServCellIndex,  numberOfN-r17 INTEGER{1..4},  mpe-ResourcePool-r17 SEQUENCE (SIZE(1..maxMPE-Resources-r17)) OF MPE-Resource-r17,  ...  }  MPE-Resource-r17 ::= SEQUENCE {  mpe-ResourceId-r17 INTEGER (1..maxMPE-Resources-r17),  mpe-ReferenceSignal-r17 CHOICE {  csi-RS-Resource-r17 NZP-CSI-RS-ResourceId,  ssb-Resource-r17 SSB-Index  }  }  maxMPE-Resources-r17 INTEGER ::= 64 -- Maximum number of pooled MPE resources |
| Intel | Nokia’s change looks aligned with our understanding. But, the location should be changed as these are per BWP. |
| Apple | For the parameters of *numberofN and mpe-ResourcePoo*l, the configuration should be per BWP per serving cell. |
| Qualcomm | All the parameters in the RAN1 list above can be added to BWP-UplinkDedicated. |
| ZTE | Nokia’s change seems fine to us, but it is still not per serving cell per BWP. |
| Samsung | Nokia’s version could be the baseline but the actual location can be changed based on the RAN1 confirmation regarding the BWP-level location on these parameters. |
| CATT | Fine to Nokia’s change, but, it should be per serving cell per BWP not just per serving cell. |
| Fujitsu | Nokia’s version is fine to us. |
| LGE | Same understanding with ZTE, Samsung and CATT. |
|  |  |

**Summary 1b**: TBD.

**Proposal 1b**: TBD.

## 3.2 PHR reporting with MPE: MAC

In the summary document [R2-2201699](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201699.zip), it was proposed (see below) that the PHR MAC CE design for MPE needs to be determined before progressing the mTRP PHR formats.

**Proposal 29: Before discussing the detailed PHR MAC CE design, RAN2 needs to determine whether Rel-17 MPE changes are applicable to mTRP framework.**

To progress with the Rel-17 MPE changes, it should first be considered how the Rel-16 MPE reporting was defined - this is shown below:



**Figure 1. Rel-16 MPE reporting, single-entry PHR**



**Figure 2. Rel-16 MPE reporting, multi-entry PHR**

Hence, the Rel-16 MPE reporting is done per serving cell, combined with PCmax,f,c and PH value for each cell. The multi-entry PHR also indicates whether the PHR is real or virtual (via the V-bit). Based on the RAN1 information, the PHR MAC CE can also contain additional beam information, selected from the configured *mpe-ResourcePool*, for each serving cell where inter-cell beam management is configured. What remains to be defined is what should be reported for each beam. The running MAC CR(in [R2-2200660](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200660.zip)) did not yet implement a proposal for these (as they had not been discussed yet in RAN2), the question on **what to report** for each beam needs to be determined. It's obvious that for each beam, the following needs to be reported:

1. **Beam identity** (referring to the *mpe-ResourcePool*)
2. **MPE value** of the beam
3. **PCMax,f,c** of the beam

### **Question 2a**: Do you agree that the information A-C needs to be included for each beam as the MPE purposes?

|  |  |  |
| --- | --- | --- |
| Answers to Question 2a | | |
| Company | Yes/No | Technical Arguments |
| OPPO | A/B,yes  C, No | We don’t think C is needed. For legacy PHR report, PCMax,f,c will be reported only for the real transmission and is dropped for the virtual transmission since this parameter can be derived based on some default value as indicated in section 7.7.1 (38.213). we think this principle should be still applied for per beam report. In addition RAN4 has not introduced any per beam PCMax,f,c yet. |
| Vivo | Comments on A and B,  FFS on C | For A and B, there are related conclusions in RAN1:   * For N P-MPR reported by UE, N is defined as the number of reported measurements * For each P-MPR value, 1 SSBRI/CRI is selected by the UE from a candidate SSB/CSI-RS resource pool   We could find that it has not agreed in RAN1 whether A represents panel or beam. There is also no common understanding in RAN1. In this way, we think it is better to use a general terminology for this RS index, e.g. we suggest to change it like:   1. **~~Beam identity~~** SSBRI/CRI (referring to the *mpe-ResourcePool*) 2. **MPE value** ~~of the beam~~ corresponding to the SSBRI/CRI   Regarding C, I assume it has not been agreed in RAN1. I think we cannot just extend to apply PCmax to per P-MPR in RAN2. Thus, we suggest to keep FFS on C.  If companies think this is really needed, we think RAN1 should be consulted first. |
| Ericsson |  | The RAN1 Agreements mention A and B. We are not sure whether PcMax,f,c needs to be reported for each MPE value (it is not so obvious that C needs to be reported per MPE value). Regarding C, whether C needs to be reported per MPE value in the MAC CE needs to be checked with RAN1 and/or RAN4 via an LS.  In the existing PHR mac CE, an MPE is not reported if it is below a threshold. The P field controls whether the MPE is reported or not. Given RAN1 has provided mpe-Threshold-r17 in the RRC excel sheet, and made the following agreement:  **Agreement**  On Rel.17 enhancements to facilitate MPE mitigation, support the following enhancement on the Rel-16 event-triggered P-MPR-based reporting (included in the PHR report when a threshold is reached, reported via MAC-CE):   * In addition to the existing field in the PHR MAC-CE, N≥1 P-MPR values can be reported   + The N P-MPR values are reported together with the following:     - For each P-MPR value, up to M SSBRI(s)/CRI(s), where the SSBRI(s)/CRI(s) is selected by the UE from a candidate SSB/CSI-RS resource pool (FFS: how to perform the selection)       * Support M=1   Based on the highlighted part, each of the N P-MPR values are only reported when the threshold is reached. So we think a P field is needed for each of the N MPE fields included in the MAC CE (i.e., N different P fields to control which MPE values are reported based on comparison with the threshold). We suggest to add the P field to A and B. |
| Huawei, HiSilicon | No | We think PCMax,f,c is per cell  About beam identity, if the number of resource per cell is not large, a bitmap could be more compact than an Id |
| Nokia, Nokia Shanghai Bell | A+B+C | PcMax,f,c is per beam since MPE is per beam: the MPE granularity is 3 dB, while PcMax,f,c uses 1dB granularity (as per 38.133, table 10.1.18.1-1). Therefore, the PcMax,f,c allows for more accurate power calculations than only the MPE field. |
| Intel | Yes for A & B, but FFS for C | We wonder if Pcmax,f,c is different for each beam. We can check with RAN1 or RAN4.  Just to clarify, we understand that beam index here is SSBRI or CRI. |
| Apple | Yes for A,B  FFS for C | RAN1 agreements mention A and B, but doesnot mention C.  For Pcmax.f.c, it’s just the per cell power info which is related to the acturaly transmission. It’s unclear how to use the legacy Pcmax.f.c with the per beam MPE reporting. We need to check with RAN1 and RAN4. |
| Qualcomm | A and B | These are the only per-beam parameters. |
| ZTE | Yes for A,B  FFS for C | We also don’t think C shall be reported per beam. |
| Samsung | Yes for A,B  FFS for C | C is not clear from RAN1 agreements so it should be checked by RAN1. |
| CATT | Yes for A,B  FFS for C | For A and B, maybe it's better to use SSBRI/CRI instead of beam in current period, more clarification is needed from RAN1.  For C, we need to check with RAN1 and RAN4 as companies mentioned above. |
| Fujitsu | A+B | For C, we can check whether it should be reported per cell or per beam with RAN1/4. |
| LGE | A and B | For C: PCMax,f,c, our understanding is per cell and it should be check with RAN1. |

**Summary 2a**: TBD.

**Proposal 2a**: TBD.

The fields B and C are obviously as in legacy, but the size of the A (beam identity) is unclear.

### **Question 2b**: How many bits need to be used for A (beam identity information)?

|  |  |  |
| --- | --- | --- |
| Answers to Question 2b | | |
| Company | Number of bits | Technical Arguments |
| OPPO | 8 bits | We think 8 bit is needed. the 1st bit could be used to differentiate the detail reference signal. If it is SSB-index, then 6 bits are used; if it is NZP CSI RS, the rest 7 bits could be used as NZP CSI-RS resource index within mpe-ResourcePool-r17 assuming the total reference signal will be less than 128 even in future. Note the similar way is used to indicate reference signal for SRS spatial relation indication. |
| vivo | No strong view | It could be similar as the size of SSB/CSI-RS pool for beam management. |
| Ericsson | Depends on pool size | This index can be resource index in the configured pool. We assume we need anyway ask RAN1 about the poolsize as it is open in RRC. FFS which LS, could be in RRC LS or MPE specific LS if such is sent,. |
| Huawei, HiSilicon |  | The value range is TBD by RAN1. As commented above, for small number, a bitmap could be more compact. |
| Nokia, Nokia Shanghai Bell | 6-7 bits | CRI/SSBRI requires 6 bits in Rel-15. Assuming we combined both, 7 bits should be sufficient. However, it would be fine to ask this from RAN1 as they have still been discussing it. |
| Intel | Depend on pool size | It should be limited by how many beams can be configured in mpe-resource pool.  Our understanding is RAN1 finalize this value and it is likely 64. |
| Apple |  | It depends on the value range which is TBD. |
| Qualcomm | At most 8 bits | Agree that we should determine the max MPE resource pool size first and use log2 of that. |
| ZTE | TBD |  |
| Samsung | Depends on pool size |  |
| CATT | TBD |  |
| Fujitsu |  | Check with RAN1. |
| LGE | comment | We think it depends on how many SSB/CSI-RS resource is configured for *mpe-ResourcePool*, and it is the RAN1 scope that determines how many resource is configured. For example, the maximum number of NZP-CSI-RS-ResourceId is 192, but we believe that RAN2 does know how many resource should be configured for *mpe-ResourcePool*. |

**Summary 2b**: TBD.

**Proposal 2b**: TBD.

The difference between single-entry and multi-entry PHR is the presence of the V-bit in the multi-entry PHR. Since the MPE beam information is, by nature, virtual, this difference doesn't seem necessary. Hence, it seems natural to use the same structure for both single-entry and multi-entry PHR.

### **Question 2c**: Can the same structure be used for the MPE beam information in single-entry and multi-entry PHR?

|  |  |  |
| --- | --- | --- |
| Answers to Question 2c | | |
| Company | Yes/No | Technical Arguments |
| OPPO | Yes |  |
| vivo | Yes |  |
| Ericsson | yes | The only difference is that the V field that indicates virtual or actual PH is not needed in the case of single-entry PHR.  But the overhead of multi-entry MAC CE may become large if we go with a fixed size single-entry MAC CE. One way to control this overhead is to consider a variable size single-entry MAC CE as only the MPE values that reach the threshold need to be reported. |
| Huawei, HiSilicon | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes | If possible, same design is preferred. For single-entry PHR, we agree with Ericsson that variable-size PHR may be needed (same as with multi-entry PHR). |
| Intel | Yes | We can probably make it same structure. |
| Apple | Yes |  |
| Qualcomm | Yes |  |
| ZTE | Yes, if possible |  |
| Samsung | Yes |  |
| CATT | Yes |  |
| Fujitsu | Yes |  |
| LGE | Yes |  |

**Summary 2c**: TBD.

**Proposal 2c**: TBD.

Finally, since the MPE information can extend the size of the PHR potentially quite a lot, and is new to Rel-17, RAN2 should decide how this is implemented in MAC CE:

1. Introduce a new PHR MAC CE with new (e)LCID(s) for Rel-17 MPE
2. Extend the legacy PHR MAC CE(s) for Rel-17 MPE

### **Question 2d**: Which option 1 to choose for the MAC CE containing Rel-17 MPE information?

|  |  |  |
| --- | --- | --- |
| Answers to Question 2d | | |
| Company | Option 1 / Option 2 | Technical Arguments |
| OPPO | Option 2 | When legacy MPE report is introduced, it trigger is also taken as general “PHR” apart from the control of prohibit timer. From the parameters input from RAN1, we think per beam MPE should also share same scheme as such that legacy part of the PHR will be also reported. A new MAC means not only one more LCID consumption, but also extra signalling overhead especially for multiple entries format. |
| vivo | Option 2 | Slightly prefer option 2 due to less spec impact. Legacy PHR MAC CE could be naturally extended to support MPE in Rel-17. |
| Ericsson | 1 | Cleaner. However, before decisions, RAN2 should discuss what is the total number of new MAC CEs planned. Is there going to be new PHR MAC CEs for mTRP and new MPE MAC CEs for BM and maybe then also new MAC Ces for mTRP for PHR and MPE? If the last is true, then that combination should be attempted first. Otherwise we may end up specifying quite many new MAC Ces here. |
| Huawei, HiSilicon | Option 1 | A new MAC CE format (not extension) gives more flexibility in the design.  A new LCID avoids confusion in case of reconfiguration changing the MAC CE format used by the UE near the time of sending the PHR and the change of configuration does not allow to distinguish what is sent before and after the reconfiguration. |
| Nokia, Nokia Shanghai Bell | Either | No strong view from our side - a new MAC CE would allow cleaner design |
| Intel | Option 1 | The structure seems different from the legacy one. Prefer a new (e) LCID. |
| Apple | Option 2 | It’s our understanding that the R17 MPE reporting may possibly work together with the R17 mTRP PHR reporting.  If the new LCID is introduced for R17 MPE reporting, and another new LCID is introduced for the R17 mTRP PHR reporting, when both features are enabled, then we have to introduce the 3rd LCID for the combined case. It will cose more LCIDs.  Therefore, the simple way is to just rely on RRC configuration to decide the PHR format and no new LCID value is introduced. |
| Qualcomm | Option 1 | Prefer Option 1 to have a clean and separate. Can accept Option 2. |
| ZTE | 1 | We tend to share the same view with Ericsson. In RAN2#116 emeeting, the following agreements are achieved:   * RAN2 to discuss how to support PHR reporting for mTRP PUSCH repetition, and may address e.g: * New MAC CE design including the function which TRP is applied for PHR reporting. * How to incorporate the additional MPE information coming in Rel-17 to the new PHR format * Whether use legacy parameters (timer, threshold, etc.) or adding TRP specific parameters * PHR triggering conditions   So we think there maybe one new MAC CE can serve both MPE and PHR, it can be studied in a higher priority. |
| Samsung | Option 1, but | Prefer Option 1 to have a clean and separate. Can accept Option 2.  We share the view of Ericsson as well, this can be further discussed after RAN1 response if the mTRP PHR report is applicapble to R17 MPE restriction. |
| CATT | Option 1 | Introduce a new MAC CE allows clear and flexible design. |
| Fujitsu | Option 1 | We prefer a clean solution. |
| LGE | Option 1 | We prefer to introduce a new PHR MAC CE for Rel-17 to separately repot MPE information.  Considering the number of reported P-MPE value can be extended to 4, the size of PHR may be huge and the extended PHR may not transmitted due to UL grant size, if legacy PHR is extended. |

**Summary 2d**: TBD.

**Proposal 2d**: TBD.

## 3.3 PHR reporting with mTRP

For mTRP, RAN1 has decided that PHR reporting can be done for both TRPs. This essentially means that the existing per-cell PHR information is repeated per TRP, which seems very straightforward for the pure mTRP case, as the example below (for single-entry PHR, excerpted from [R2-2201058](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201058.zip)) shows:



### **Question 3a**: Does the above structure for the mTRP-only PHR MAC CE format capture the necessary changes for Rel-17?

|  |  |  |
| --- | --- | --- |
| Answers to Question 3a | | |
| Company | Yes/No | Technical Arguments |
| OPPO | Yes but | But for the detail PHR report, we need consider the updated PHR report as a whole format considering some serving cell(s) maybe configured to report per beam MPE while other sevign cell(s) maybe configured to report PHR of 2nd TRP assuming no new MAC CE is introduced. |
| vivo | No | Firstly, we think it is better to replace TRP1 and TRP2 with the 1st SRS resource set and the 2nd SRS resource set, because there is no way to distinguish TRP1 and TRP2 out of TRPs.  Secondly, there is no agreement in RAN1 on reporting P-MPR per TRP within the same MAC-CE. So, we suggest to keep FFS on the fields of P, MPE or R in the extended octet. |
| Ericsson | Some starting point | On the level that it has two PH values yes. As pointed out above, we should ask RAN1/4 about Pcmax.  Secondly, depends if more MPE values are needed or not. |
| Huawei, HiSilicon | Yes but | for multiple entry, in case of a reconfiguration close to the sending of a PHR MAC CE, e.g. add mTRP for one SCell and remove it for another SCell, the network may interpret the MAC wrongly (shift in SCells). Could discuss how to avoid this (e.g. additional bitmap). |
| Nokia, Nokia Shanghai Bell | Yes as starting point | This is the "simple" starting point to illustrate the intent of the mTRP PHR. We agree that all the aspects need to be considered |
| Intel | Yes | It is simpler to extend it for both TRPs. |
| Apple | Yes | It could be the starting point. And the following points may need to be clarified:   1. How to set the P bit per TRP; 2. V bit for both TRP-PH should not be set to 0 for the single-entry PHR case. |
| Qualcomm | Yes | Good as a baseline. |
| ZTE | Yes |  |
| Samsung | Yes as starting point |  |
| CATT | Yes | Maybe as a baseline. |
| Fujitsu | Yes |  |
| LGE | Yes | In Multiple entry PHR MAC CE case, there may be a case that some serving cell are configured with mTRP but the other serving cell are not configured. The PH value may be obtained differently for the cell configured with mTRP and the cell not configured mTRP. That is, whether PH value is obtained per TRP or per cell should be specified clearly. However, we think this can be specified without difficulty. |

**Summary 3a**: TBD.

**Proposal 3a**: TBD.

Next, the same topic as considered for the Rel-17 MPE MAC CE needs to be considered: Is new MAC CE (i.e. with different LCID) needed for the mTRP PHR, i.e. which option out of the following is chosen:

1. Introduce a new PHR MAC CE with new LCID(s) for Rel-17 mTRP
2. Extend the legacy PHR MAC CE(s) for Rel-17 mTRP

Additionally, these can also have different sub-options:

1. Same MAC CE reports PHR for both TRPs
2. One MAC CE only reports PHR for a single TRP (with TRP ID included)

Note that these options were also (partly) mentioned in the summary documentin [R2-2201699](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201699.zip) as shown below:

|  |
| --- |
| **Proposal 30: RAN2 to determine if both mTRP’s PHRs are reported in a single multi-TRP MAC-CE instance.**   1. **Option 1: Introduce a new MAC-CE for multi-TRP PHR where both PHRs are reported in a single multi-TRP MAC-CE instance.** 2. **Option 2: Introduce a new MAC-CE for multi-TRP PHR where one PHR are reported in a single multi-TRP MAC-CE instance i.e. TRP identifier is included in the MAC CE.** |

Obviously, these can be combined so the final choice should be between options 1A, 1B, 2A and 2B.

### **Question 3b**: Which option to adopt for the mTRP MAC CE definition?

|  |  |  |
| --- | --- | --- |
| Answers to Question 3b | | |
| Company | Option (1A, 1B, 2A, 2B) | Technical Arguments |
| OPPO | 1B or 2A, but to be discussed further | We need first decide whether there will be new trigger or not. In case of there will be new trigger, whether this trigger is taken as general “PHR” or not. If eventually legacy PHR information will be anyway reported, then only 1B and 2A are valid combination. We think there is no reason not to follow existing PHR frame work i.e. legacy PHR information will be any reported. Between 1B and 2A, there is trade off between clean format and signalling overhead. But this should be discussed as a whole together with per beam MPE part. We need first figure out detail PHR format to judge which one is better. |
| vivo | 2A | Option 2A is simper, and we don’t see any potential problem to extend legacy MAC CE. |
| Ericsson | Option 1A | If these are reported in different MAC CEs network does not receive these at once and thus cannot schedule from both TRPs. It may also be that deriving PHR to one and the other TRP have some dependency thus that is another reason why these should arrive to network at same time to be useful. Also one Mac CE may get lost. |
| Huawei, HiSilicon | 1A | Same reasoning as above for 1 vs. 2. B would have a little more overhead. |
| Nokia, Nokia Shanghai Bell | 1A or 2A | Either option is fine to us. |
| Intel | 1A | All options are feasible. Triggering is independent for each TRP as pathloss would be independent. But gNB might want to get both of them to decide scheduling purpose. If we provide PHR of both TRPs, option 1 is clean. |
| Apple | 1A | It’s better for NW to acquire both TRP’s PH info together for the subsequent UL power scheduling. |
| Qualcomm | 1A | Can accept 2A |
| ZTE | 1A | 1A is simpler and clearer. |
| Samsung | 1B or 2A  but to be discussed further | We agree OPPO that the decision of PHR format should consider the functionality e.g. triggering condition, etc.  We also agree that all options are feasible but flexible usage point of view, 1B/2A have advantage in terms of independent PHR triggering/ report for each TRP.  Option 1A has a restriction that always PHR for both TRPs are reported e.g. how to handle the UL grant is not large enough to accommodate both PHR. |
| CATT | 1A | We prefer 1A |
| Fujitsu | 1A |  |
| LGE | 2A or 1A | We think the legacy PHR can be easily extended with including PHR for both TRPs, or new PHR including both TRP can be introduced. |

**Summary 3b**: TBD.

**Proposal 3b**: TBD.

## 3.4 SI handling

The handling of SI and short message reception during ICBM operation has also been discussed in some contributions, notably [R2-2200569](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200569.zip), [R2-2201275](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201275.zip) and P5 of [R2-2201098](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201098.zip), with the following proposals:

|  |  |
| --- | --- |
| Contribution | Proposals |
| [R2-2200569](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200569.zip) | **Proposal: The network can provide system information through dedicated signalling for a UE in RRC\_CONNECTED using the RRCReconfiguration message when the active TCI state for the UE is associated with a PCI different from serving cell PCI.** |
| [R2-2201275](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201275.zip) | **Proposal 1: Support reception of short message and SIBs from the serving cell while the aTRP is used (i.e. is the active or indicated TCI state). Confirm the solution with RAN1.**  **Proposal 2: If RAN2 is to support dedicated SI delivery of SIB6, 7, and 8 for the inter-cell BM case, the field description of *dedicatedSystemInformationDelivery* should be updated as follows.**  ***dedicatedSystemInformationDelivery***  This field is used to transfer *SIB6*, *SIB7*, *SIB8* to the UE with an active BWP with no common serach space configured or to the UE with an active BWP with aTRP. For UEs in RRC\_CONNECTED, this field is used to transfer the SIBs requested on-demand. |
| [R2-2201098](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201098.zip) | **Proposal 5: In inter-cell BM, if the UE is receiving DL data from TRP with different PCI, RAN2 to discuss how the UE receive short message/paging.**  **Option 1: the TRP with different PCI sends beam switch command to let these UEs switch beam back to the serving cell TRP.**  **Option 2: the network uses dedicated RRC signalling to convey the updated SI (including ETWS/CMAS).**  **Option 3: the network informs the UE that the UE shall acquire paging/short message/SI from the cell of the TRP with different PCI and the network coordinates paging/short message/SI across cells. This solution can be used when allowed by the network deployment.** |

Both [R2-2200569](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200569.zip) and [R2-2201275](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201275.zip) propose to reuse the existing signalling via RRCReconfiguration at least for system information. [R2-2201275](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201275.zip) notes that UE still listens to the CSS from pTRP anyway, so it should be possible to anyway receive also short messages, but this may require additional specification in RAN1, and it is proposed to confirm from RAN1 that this works. Finally, [R2-2201098](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201098.zip) provides three different options for discussion, which are the same as the other contributions but consider also allowing NW to indicate that UE should acquire SI/short message from aTRP. Since the three options from seem to represent all of these, it is proposed to consider which one to adopt:

**Option 1:** the TRP with different PCI sends beam switch command to let these UEs switch beam back to the serving cell TRP. ([R2-2201275](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201275.zip), [R2-2201098](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201098.zip))

**Option 2:** the network uses dedicated RRC signalling to convey the updated SI (including ETWS/CMAS). ([R2-2200569](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200569.zip) and [R2-2201275](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201275.zip))

**Option 3:** the network informs the UE that the UE shall acquire paging/short message/SI from the cell of the TRP with different PCI and the network coordinates paging/short message/SI across cells. This solution can be used when allowed by the network deployment. ([R2-2201098](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201098.zip))

### **Question 4**: Which option to adopt for the SI and short message reception when ICBM is configured to UE?

|  |  |  |
| --- | --- | --- |
| Answers to Question 4 | | |
| Company | Option 1/2/3 | Technical Arguments |
| Docomo | Other | We prefer receiving short message and SI from pTRP. Though this option would require RAN1 confirmation, we suggest confirming that this option is feasible from RAN2 point of view.  We do not prefer Option 1 and 2, which would work with no/little spec impact but lead to potential additional delay and inefficiency.  We are not sure if Option 3 works, as RAN1 stated in LS R1-2110631 that The system information for inter-cell beam management can be only received from the serving cell TRP. |
| OPPO | Others | We think this issue can be treated just like what current spec does for CA case. In case there is SIBs relevant to UE’s operation in CONNECTED state, it can be delivered via dedicated RRC signalling e.g. SIB1. Otherwise network can choose not to schedule UE in aTRP and then UE supposes to turn to serving TRP at the occasion for short message or system information to check whether anything can be received. But all these scheme are mature today i.e. nothing more is needed at all. |
| vivo | Option 1 | 1. We think it should be common understanding in RAN2 that short message and SI should be received from pTRP. Otherwise, we need more discussion on it in RAN2. In this way, option 3 is out. 2. Then, we could discuss how to ensure the short message and SI reception during ICBM operation. Our understanding is UE needs to perform beam switching back to aTRP for short message and SI reception. We donot think beam switch command is needed for this operation. |
| Ericsson | other | Per network implementation network ensures UE can time to time or when needed have UE specific PDCCH and PDSCH steered such that UE can also receive SI from the cell that has these two TRPs. Already in Rel-15/16 UE may be receiving PDSCH with a narrow beam and may not at same time receive with wide beam(SI). |
| Huawei, HiSilicon | 1+2+3 if time allows, otherwise 1+2 | For the purpose of completion of this WI, the easiest and most flexible is option 1 + option 2 i.e. the UE is still required to monitor short message and SI from TRP with the same PCI when it is receiving from that TRP, and either the network will switch the UE back to the serving cell TRP to receive short message and SI or the network will send the SI via dedicated signalling.  Option 3's intention is, in deployments where SI will be common between multiple cells, to further require the UE to monitor short message and SI from the TRP the UE is currently receiving, which could be the TRP with a different PCI. For the UE, this is easier than the suggestion from Docomo above.  That option implies some restriction to TRP switching (should not occur in the middle of SI change) but the network can avoid sending dedicated signalling to UEs using in the TRP with different PCI at the time of SI change. |
| Nokia, Nokia Shanghai Bell | 1+2 | We would be simply fine to use dedicated signalling for SI, but for short message it may be that NW has to move UE back to pTRP first. |
| Intel | Option 1+2. (+ option 3 with clarification) | Option 1+ 2 can be baseline as it doesn’t give any impact to the current specification. While it is true that dedicated signalling is inefficient in option 2, it is used in many other cases already, even in LTE when UE cannot acquire SIB. Also the volume of PWS signalling should not be significant compared to the user data. And during times of PWS (which should be rare), this will be prioritised over user data.  Regarding option 3, if we assume that UE will continue receiving based on serving cell’s configuration, there is no/minimal specification impact i.e. network implementation. If it is correct, option 3 is also possible. |
| Apple | Option 1+2 | It can be up to NW implementation whether to go for Option 1 or Option 2. |
| Qualcomm | Option 1 or 2 | This is pure NW implementation though. |
| ZTE | Option 1+2 | We have no time to discuss how to implement option 3, regarding Option 1or Option 2, it is up to RAN2 to decide, in RAN2, we only assume it is up to NW implementation |
| Samsung | Option 1+2 | These options (option 1 and 2) are allowed in the legacy implementation and not allowing these options require the new restriction on the ICBM. |
| CATT | Option 2 or 1 | Up to NW implementation. |
| Fujitsu | Option 2 | Option 2 can work with little spec impact.  We understand that one possible use case where the UE transmits/receives from the TRP with different PCI is that the serving cell TRP is bad and thus Option 1 incurs additional delay and inefficiency. In the worst case, the updated SI cannot be received from the serving cell TRP.  We don’t think that Option 3 is feasible. First, UE is not required to monitor a Type0/0A/1[/2] CSS in a CORESET when the active TCI state is associated with a PCI different from serving cell PCI, as agreed in RAN1. Second, it puts some restrictions on the network deployment. |
| LGE | 1+2 | The only way to complete feMIMO is to rely on option1+2, i.e. this should be up to network implementation. Other option is not feasible in the current time frame for Rel-17, since they have impact to RAN1 and/or RAN2. |

**Summary 4**: TBD.

**Proposal 4**: TBD.

# 4 Conclusion

TBD.