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.

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| --- | --- | --- |
| Company | Name | Email Address |
| Nokia (Rapporteur) | Tero Henttonen | tero.henttonen@nokia.com |
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# 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):

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| **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 report1=P-MPR report | {0, 1} | Per UE per cell per BWPin [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 BWPin [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 BWPin [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 BWPin [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 valuesIn 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 BWPin [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 RAN2Applies 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)?

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| Answers to Question 1 |
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**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).

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| 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-STARTPHR-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 |
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**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?

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| Answers to Question 2a |
| Company | Yes/No | Technical Arguments |
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**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)?

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| Answers to Question 2b |
| Company | Number of bits | Technical Arguments |
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**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?

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| Answers to Question 2c |
| Company | Yes/No | Technical Arguments |
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**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?

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| Answers to Question 2d |
| Company | Option 1 / Option 2 | Technical Arguments |
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**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?

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| Answers to Question 3a |
| Company | Yes/No | Technical Arguments |
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**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:

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| **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.**
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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?

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| Answers to Question 3b |
| Company | Option (1A, 1B, 2A, 2B) | Technical Arguments |
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**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:

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| 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?

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| Answers to Question 4 |
| Company | Option 1/2/3 | Technical Arguments |
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**Summary 4**: TBD.

**Proposal 4**: TBD.

# 4 Conclusion

TBD.