3GPP TSG-RAN WG2 Meeting #109bis-e [R2-200xxxx](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-200xxxx.zip)

Elbonia, 20 – 30 April 2020

**Agenda item: 6.19**

**Source: Nokia (discussion rapporteur)**

**Title: Discussion of MPE contributions in AI 6.19**

**Document for: Discussion and Decision**

# 1 Brief scope of the LTE legacy contributions

This document contains the summary and discussion on documents related to the RAN4 request to handle MPE as shown below:

MPE enhancements FR2

[R2-2002527](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002527.zip) LS on MPE enhancements (R4-1916183; contact: Qualcomm) RAN4 LS in Rel-16 NR\_RF\_FR2\_req\_enh To:RAN2

[R2-2002534](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002534.zip) LS on MPE enhancements (R4-2002916; contact: Nokia) RAN4 LS in Rel-16 NR\_RF\_FR2\_req\_enh To:RAN2

1 doc moved here from 6.20.3.1 :

[R2-2002820](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002820.zip) P-MPR Reporting Apple discussion Rel-16 NR\_RF\_FR2\_req\_enh

[R2-2002684](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002684.zip) UE FR2 MPE enhancements and solutions Nokia, Nokia Shanghai Bell discussion Rel-16 NR\_RF\_FR2\_req\_enh

[R2-2002685](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002685.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.331 16.0.0 1515 - B NR\_RF\_FR2\_req\_enh

[R2-2002686](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002686.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.321 16.0.0 0707 - B NR\_RF\_FR2\_req\_enh

[R2-2002687](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002687.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.306 16.0.0 0272 - B NR\_RF\_FR2\_req\_enh

[R2-2002688](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002688.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.300 16.1.0 0210 - B NR\_RF\_FR2\_req\_enh

* [AT109bis-e][041][NR16 Other] MPE enhancements FR2 (Nokia)

Scope: Treat papers above on MPE enhancements FR2

Wanted Outcome: Agreed-in-principle CRs

Deadline: April 28 0700 UTC

# 2 Summary of MPE contributions

## 2.1 LS input from RAN4

RAN 4 has sent two LSs to RAN2 on the MPE as per [1] and [2]. The content of these is summarized below.

|  |  |
| --- | --- |
| **Tdoc(s), Title, Company** | **Summary of content** |
| 1) [R2-2002527](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002527.zip) LS on MPE enhancements (R4-1916183; contact: Qualcomm) RAN4 LS in Rel-16 NR\_RF\_FR2\_req\_enh To:RAN2 | Informs RAN2 that MAC CE signalling from UE to inform network about the FR2 MPE may be needed. |
| 2) [R2-2002534](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002534.zip) LS on MPE enhancements (R4-2002916; contact: Nokia) RAN4 LS in Rel-16 NR\_RF\_FR2\_req\_enh To:RAN2 | Requests to create MAC CE signalling from UE to network according to following:* Event-triggered reporting of FR2 P-MPR level via the MAC CE
* Network-configurable prohibit timer for the MAC CE
* P-MPR reporting range to be confirmed by RAN4 later on
* The reporting mechanism should ensure sufficiently short signalling delays
 |

These seem rather straightforward requests, and although it is clear that RAN4 discussion hasn’t yet concluded on all aspects, there doesn’t seem to be anything blocking from starting the discussion in RAN2 (given that there are also contributions on the topic).

**Observation 1:** RAN4 is requesting RAN2 to define FR2 MPE P-MPR reporting via MAC CE from UE to network.

## 2.2 MPE contributions in RAN2

The contributions in [3] and [4] discuss the general topics, whereas the CRs in [5], [6], [7], [8] illustrate one version of the MPE signalling from UE to network.

1 doc moved here from 6.20.3.1 :

[R2-2002820](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002820.zip) P-MPR Reporting Apple discussion Rel-16 NR\_RF\_FR2\_req\_enh

[R2-2002684](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002684.zip) UE FR2 MPE enhancements and solutions Nokia, Nokia Shanghai Bell discussion Rel-16 NR\_RF\_FR2\_req\_enh

[R2-2002685](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002685.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.331 16.0.0 1515 - B NR\_RF\_FR2\_req\_enh

[R2-2002686](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002686.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.321 16.0.0 0707 - B NR\_RF\_FR2\_req\_enh

[R2-2002687](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002687.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.306 16.0.0 0272 - B NR\_RF\_FR2\_req\_enh

[R2-2002688](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002688.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.300 16.1.0 0210 - B NR\_RF\_FR2\_req\_enh

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| --- | --- |
| **Tdoc, Title, Company** | **Proposal(s)** |
| 3) [R2-2002820](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002820.zip) P-MPR Reporting Apple discussion Rel-16 NR\_RF\_FR2\_req\_enh | **Summary:** Proposes to utilize existing PHR MAC CE for FR2 MPE P-MPR reporting, including reusing the existing PHR prohibit timer and allowing only 4 values to be reported.**Exact proposals:****Proposal 1:** Enhance existing single and multiple entry PHR MAC CE to carry the P-MPR information.**Proposal 1a:** In PHR with P-MPR MAC CE, two R bits in the octet of Pcmax.f.c is allowing for P-MPR with 4 different values (exact values will be captured by RAN4 in TS 38.133).**Proposal 2:** Rely on legacy *phr-ProhibitTimer* to control the frequency of the PHR with P-MPR reporting. **Proposal 3:** PHR MAC CE format with P-MPR information should be enabled via RRC signalling.  |
| 4) [R2-2002684](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002684.zip) UE FR2 MPE enhancements and solutions Nokia, Nokia Shanghai Bell discussion Rel-16 NR\_RF\_FR2\_req\_enh | **Summary:** Define new MAC CE for FR2 MPE P-MPR reporting, including having a new prohibit timer, per-UE capability and event-triggered condition for sending the MAC CE.**Exact proposals:****Proposal 1:** Define a new UL MAC CE that indicates the FR2 P-MPR exceeds a given threshold due to FR2 MPE limits.**Proposal 2:** FR2 MPE P-MPR reporting events and prohibit timer are specified in MAC specification.**Proposal 3:** FR2 MPE P-MPR reporting is configured per MAC entity but is only applicable for FR2 serving cells.**Proposal 4:** Define event-based FR2 MPE P-MPR reporting in MAC that triggers when P-MPR > P-MPR\_Threshold (MPE event occurs) or when P-MPR < P-MPR\_Threshold (e.g. similar to reportOnLeave for RRM).**Proposal 5:** Define a per-UE capability for FR2 MPE P-MPR reporting, applicable only to FR2 carriers.**Proposal 6:** Endorse the CRs in CRs in [R2-2002688](http://www.3gpp.org/ftp/tsg_ran/wg2_rl2/tsgr2_109bis_e/docs/R2-2002688.zip) (38.300), [R2-2002685](http://www.3gpp.org/ftp/tsg_ran/wg2_rl2/tsgr2_109bis_e/docs/R2-2002685.zip) (38.331), [R2-2002686](http://www.3gpp.org/ftp/tsg_ran/wg2_rl2/tsgr2_109bis_e/docs/R2-2002686.zip) (38.321) and [R2-2002687](http://www.3gpp.org/ftp/tsg_ran/wg2_rl2/tsgr2_109bis_e/docs/R2-2002687.zip) (38.306) as baseline for FR2 MPE P-MPR reporting while waiting for further RAN4 feedback.**Proposal 7:** Continue MPE discussion via email discussion until RAN2#110e. |
| 5) [R2-2002685](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002685.zip), [R2-2002686](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002686.zip), [R2-2002687](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002687.zip), [R2-2002688](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002688.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR | **Proposed CRs**CR content to MAC, RRC, 38.306 and Stage-2 according to the Nokia proposals in [R2-2002684](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002684.zip) |

Based on these, it seems there are at least the following questions to be considered in RAN2:

* Whether to create new MAC CE or reuse existing MAC CE?
* How are the conditions for triggering the MAC CE defined?
* How to ensure sufficiently short signalling delays for the MAC CE?
* How is the RRC configuration for the MAC CE reporting done?
* What kind of UE capabilities are needed?

Based on these, the next section contains discussion topics for each of these questions. In case other questions should be discussed, companies are requested to indicate them here.

|  |  |
| --- | --- |
| **Company** | **Are there any other questions than the 4 above that need to be discussed in RAN2?** |
| Apple | Question#1,2,4,5 should be discussed in RAN2 according to RAN4 request. But for question#3, We donot need to take it into account for the MAC CE design. RAN4 has discussed three major ways how the P-MPR related information can be conveyed - PHY, MAC, RRC - and finally concluded that MAC based approach is sufficiently fast. Thus, RAN2 does not need to re-open the same discussion.  |
| Nokia, Nokia Shanghai Bell | Question 3 was explicitly cited in the RAN4 LS so needs to be taken into account. See our replies to that.  |
|  |  |

**Table 1. Additional questions to be discussed in RAN2 about FR2 MPE P-MPR reporting?**

**Conclusions:** TBA

# 3 Discussion on RAN2 questions for MPE

## 3.1 Create a new MAC CE or reuse an existing MAC CE?

The main difference between the input contributions [3] and [4] is the approach on MAC CE: Creating a new MAC CE is more flexible but costs an LCID, whereas reusing existing (PHR) MAC CE may require less effort but also create complications to avoid impacting legacy.

Companies are requested to provide their reasoning in the tables below using one row for each new comment to better keep track of the discussion – please don’t edit the previous comments.

|  |  |
| --- | --- |
| **Company** | **Should a new MAC CE be created for FR2 MPE P-MPR reporting? Why or why not?** |
| Apple | **No. The existing legacy PHR MAC CE can, and should, be re-used because it already conveys P-MPR related information, such as Pcmax, PH and P-bit.** 1) All the aforementioned fields are set by the UE MAC entity based on the input from the corresponding RF module that makes the actual decision whether P-MPR should be applied and how much. In that sense, it is a straightforward extension for the UE side to indicate to the MAC entity by how much the transmission power was reduced. Thus, additional MPE related information can be provided in the legacy PHR MAC CE, which will reside in the same logical container and which will be received by the network at the same time.2) The existing PHR MAC CE already provides a versatile framework for configuring PHR reporting as a periodic or triggered event, whereas a new MAC CE would require RAN WG2 to re-introduce again almost the same concept.3) There is no backward compatibility issue, because the enhanced PHR MAC CE which is reusing the PHR MAC CE to carry M-PHR info is only enabled via RRC configuration.  |
| Nokia, Nokia Shanghai Bell | **Yes.** We think that would be the cleanest way and completely decouple the functionality from PHR to avoid any legacy impacts. |
|  |  |

**Table 2. Rationale for creating a new MAC CE for MPE**

|  |  |
| --- | --- |
| **Company** | **Should an existing MAC CE be reused for FR2 MPE P-MPR reporting? Why or why not?** |
| Apple | Yes. The reasons are referred to our answer in Table 2.  |
| Qualcomm Incorporated | Support reusing existing (PHR) MAC CE because it can provide comprehensive view on the UE situation. |
| Nokia, Nokia Shanghai Bell | **No:** Using legacy PHR MAC CEs would require more work than creating a new MAC CE. 1) Reusing PHR means that a PHR sent before MPE event occurs could prevent the MAC CE being sent (due to prohibit timer already being running). Changing that may also impact legacy, which requires extensive checking.2) Extending existing PHR report will increase the size of PHR (due to inclusion of P-MPR value). This makes the P-MPR report larger, which in turn may impact scheduling.3) PHR will have to consider both legacy PHR formats, which means more changes to MAC specification since both types of PHR have to be considered.4) A new MAC is much more easily dealt with at the network side since it can trigger disinctive actions based on the MPE event without interfering with existing actions based on PHR5) PHR may not always be configured, e.g. in small cells where the power headroom is not as critical for the cell coverage. |

**Table 3. Rationale for reusing an existing MAC CE for MPE**

**Conclusions:** TBA

## 3.2 How are the conditions for triggering the MAC CE defined?

RAN4 has so far indicated that an “event-triggered” condition should be allowed for the P-MPR reporting based on a P-MPR threshold. Presumably it is MAC that triggers the condition, so the change would be captured in MAC specification (as discussed in [4]), and the MAC CR [6] illustrates one way to do this.

Companies are requested to provide their reasoning in the tables below using one row for each new comment to better keep track of the discussion – please don’t edit the previous comments.

|  |  |
| --- | --- |
| **Company** | **How are the MAC CE triggering conditions defined and what are the important aspects to capture for those?** |
| Apple | RAN4 LS just indicated that at least UE’s P-MPR based event-triggered reporting, but the detail is still under RAN4 discussion. Therefore, how to specify the condition should wait for further RAN4 input.  |
| Qualcomm Incorporated | Periodic: Based on a configure periodic timer, which is separate from a prohibit timer.Event triggered:* P-MPR value exceed a configured threshold

Latest P-MPR value compare to the last value higher than or lower than a configured threshold |
| Nokia, Nokia Shanghai Bell | RAN4 has so far only requested RAN2 to provide event-triggered reporting but is also discussing periodical configuration. From Nokia viewpoint both event-triggered and periodical reporting should be supported (as also Qualcomm proposes).For the P-MPR threshold, we would note that it is an absolute threshold, not a relative one: That is, the event triggers when the applied P-MPR exceeds the threshold value, after which UE reports the (absolute) P-MPR value.  |

**Table 4. Capturing the event-triggering in specifications**

**Conclusions:** TBA

## 3.3 How to ensure sufficiently short signalling delays for the MAC CE?

The RAN4 LS [2] indicates that the signalling should have “sufficiently short signalling delays”. While the term is perhaps ambiguous, the intent is likely the fact that due to the large P-MPR incurred by FR2 MPE requirements, network should receive the information quickly to take appropriate actions (as discussed in [4]). To that end, it seems that using MAC CE (which is faster than RRC signalling) could perhaps be sufficient to ensure this.

Companies are requested to provide their reasoning in the tables below using one row for each new comment to better keep track of the discussion – please don’t edit the previous comments.

|  |  |
| --- | --- |
| **Company** | **How to guarantee “sufficiently short signalling delays” as requested by RAN4?**  |
| Apple | MPE signaling based on MAC CE has ensured the sufficiently short delay compared to RRC signaling, therefore, we donot need to take it into account for the MAC CE design.RAN4 has discussed three major ways how the P-MPR related information can be conveyed - PHY, MAC, RRC - and finally concluded that MAC based approach is sufficiently fast. Thus, RAN2 does not need to re-open the same discussion.  |
| Qualcomm Incorporated | We think it is useful to allow UE to initiate new reporting even when no UL grant is immediately available to send P-MPR MAC CE. For example, UE may use the existing SR or RACH procedure to request a UL grant to send P-MPR MAC CE, so that it does not have to passively wait for it. |
| Nokia, Nokia Shanghai Bell | We think MAC CE in itself should already guarantee this. Also, having a separate MAC CE means the content can be streamlined and smaller, which also ensures faster delivery, which is another reason to have a dedicated MAC CE for MPE. |

**Table 5. How to ensure sufficiently short signalling delays**

**Conclusions:** TBA

## 3.4 How is the RRC configuration for the MAC CE reporting done?

Obviously as also the RAN4 LS [2] indicates, the FR2 MPE P-MPR reporting is configured via RRC, so RAN2 needs to develop the exact signalling for that. The CR [5] illustrates an example of this and could be discussed as a starting point for the RRC modifications.

Companies are requested to provide their reasoning in the tables below using one row for each new comment to better keep track of the discussion – please don’t edit the previous comments.

|  |  |
| --- | --- |
| **Company** | **What should be configured via RRC for the FR2 MPE P-MPR reporting? Is the CR [5] agreeable as a starting point for the RRC configuration?** |
| Apple | PHR MAC CE format with P-MPR information should be enabled via RRC signalling. According to the draft CR, we think it’s unnecessary to introduced new configuration for the PHR prohibit timer and threshold, since it’s possible to reuse the current PHR configuration for the PHR MAC CE with P-MPR reporting.  |
| Qualcomm Incorporated | Probably too early to agree on a CR. We should first agree on the mechanisms to be implemented. We agree to the proposal to introduce a new prohibit timer for the FR2 MPE P-MPR reporting. |
| Nokia, Nokia Shanghai Bell | Generally, we think the configuration is on all aspects requested by RAN4: Activation of being allowed to send the report and parameters needed for triggering the report. These are anyway needed regardless of how the MAC CE design is done, which is why we already provided a draft CR with the configuration.We would also note that the MPE cannot reuse prohibit timer from PHR: Since the FR2 MPE requirements are completely separated from triggers for existing PHR, having sent a PHR should not block from sending the FR2 MPE P-MPR report. |

**Table 6. RRC configuration details for MPE**

**Conclusions:** TBA

## 3.5 What kind of UE capabilities are needed?

Companies are requested to provide their reasoning in the tables below using one row for each new comment to better keep track of the discussion – please don’t edit the previous comments.

|  |  |
| --- | --- |
| **Company** | **What are the UE capabilities needed for the FR2 MPE P-MPR reporting?** |
| Apple | The capability to indicate whether UE support the MPE P-MPR reporting is needed.  |
| Qualcomm Incorporated | Single bit UE capability parameter seems sufficient. |
| Nokia, Nokia Shanghai Bell | Similar view as Qualcomm: Single per-UE capability bit (for FR2 only) seems sufficient. |
|  |  |

**Table 7. UE capabilities for the MPE feature**

**Conclusions:** TBA

## 3.X NEW QUESTION?

NEW QUESTION DETAILS GO HERE.

Companies are requested to provide their reasoning in the tables below using one row for each new comment to better keep track of the discussion – please don’t edit the previous comments.

|  |  |
| --- | --- |
| **Company** | **QUESTION TO ANSWER?** |
|  |  |
|  |  |
|  |  |

**Table 8. SUMMARY OF QUESTION X**

**Conclusions:** TBA

# 4 Conclusions

**Agreements proposed to be agreed in this meeting (from all sub-topics)**

**Proposal S1\_1:**

**Open items proposed to be further discussed in this meeting (from all sub-topics)**

**DISC S1\_1:**

# 5 List of referenced documents

[1] [R2-2002527](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002527.zip) LS on MPE enhancements (R4-1916183; contact: Qualcomm) RAN4 LS in Rel-16 NR\_RF\_FR2\_req\_enh To:RAN2

[2] [R2-2002534](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002534.zip) LS on MPE enhancements (R4-2002916; contact: Nokia) RAN4 LS in Rel-16 NR\_RF\_FR2\_req\_enh To:RAN2

[3] [R2-2002820](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002820.zip) P-MPR Reporting Apple discussion Rel-16 NR\_RF\_FR2\_req\_enh

[4] [R2-2002684](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002684.zip) UE FR2 MPE enhancements and solutions Nokia, Nokia Shanghai Bell discussion Rel-16 NR\_RF\_FR2\_req\_enh

[5] [R2-2002685](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002685.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.331 16.0.0 1515 - B NR\_RF\_FR2\_req\_enh

[6] [R2-2002686](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002686.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.321 16.0.0 0707 - B NR\_RF\_FR2\_req\_enh

[7] [R2-2002687](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002687.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.306 16.0.0 0272 - B NR\_RF\_FR2\_req\_enh

[8] [R2-2002688](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002688.zip) Introduction of FR2 MPE P-MPR reporting Nokia, Nokia Shanghai Bell CR Rel-16 38.300 16.1.0 0210 - B NR\_RF\_FR2\_req\_enh