**3GPP TSG-RAN WG2 Meeting #113 electronic *R2-200wxyz***

**Online, Jan 25 - Feb 5, 2021**

Agenda Item: 8.1.x.x

Source: MediaTek Inc.

**Title: [Post112-e][069][MBS] Delivery mode 2 (MediaTek)**

Document for: Discussion and decision

# Introduction

This document is to kick off the following email discussion:

* [Post112-e][069][MBS] Delivery mode 2 (MediaTek)

      Scope: Progress on solutions CP focus: MCCH or not for PTM configuration. PTM configuration change notification.

      Intended outcome: Report with agreeable proposals / identified open issues

      Deadline: Long

During last RAN2 meeting (RAN#112e), there were discussions on delivery modes for NR MBS. The delivery mode 2 is for “low” QoS requirement, where the UE can also receive data in INACTIVE/IDLE. The delivery mode 2 was assumed by RAN2 for broadcast sessions at last RAN2 meeting and it is FFS for its applicability for multicast sessions.

Agreements

=>For Rel-17, R2 specifies two modes:

1: One delivery mode for high QoS (reliability, latency) requirement, to be available in CONNECTED (possibly the UE can switch to other states when there is no data reception TBD)

2: One delivery mode for “low” QoS requirement, where the UE can also receive data in INACTIVE/IDLE (details TBD).

R2 assumes (for R17) that delivery mode 1 is used only for multicast sessions.

R2 assumes that delivery mode 2 is used for broadcast sessions.

The applicability of delivery mode 2 to multicast sessions is FFS.

As one of the post-meeting discussions for RAN#111e, [906], MBS Idle mode support was initially discussed, and the following conclusion was made during the online discussion based on the email summary (R2-2008796).

Agreements

=>UE receives the MBS configuration (for broadcast/delivery mode 2) by BCCH and/or MCCH (TBD), and this can be received in Idle / Inactive mode. Connected mode FFS (dep on UE cap and where service is provided etc). A notification mechanism is used to announce the change of MBS Control information.

According to abovementioned background, this email discussion aims to discuss the detailed CP aspects of delivery mode 2.

# Clarification of Delivery mode 2

## 2.1 Applicability of Delivery mode 2 on RRC states

According to the agreements made during last RAN2 e-meeting (i.e. RAN2#112e), there is no clear statement with regard to the RRC states for the applicability of Delivery mode 2. Rapporteur thinks it is helpful to clarify it before any discussion on other issues. Rapporteur assumes that NR MBS delivery mode 2 supports both idle/inactive UEs and connected mode UEs based on the agreements so far.

### **Question 1**

Do you agree that both idle/inactive UEs and connected mode UEs can receive MBS services transmitted by NR MBS delivery mode 2?

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## 2.2 Delivery mode 2 characteristics

As concluded during last RAN2 e-meeting, delivery mode 2 supports the transmission of MBS services with lower QoS requirement. In this case, delivery mode 2 means PTM reception only, i.e. there is no PTP-PTM switch nor PTP assistance to improve PTM quality. Delivery mode 2 may support a huge number of users (i.e. UE in idle/inactive state). To enable delivery mode 2 reception, the UE does not need to take session join and/or authentication at NAS layer. In summary, the UE receiving MBS services transmitted by delivery mode 2 is not required to interact with the network before its MBS service reception (i.e. pure broadcast delivery).

### **Question 2**

Do you agree that the UE receiving MBS services transmitted by delivery mode 2 is not required to interact with the network before its MBS service reception?

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## 2.3 Delivery mode 2 for multicast/broadcast session

According to the online discussion of RAN2#112e, RAN2 assumes that delivery mode 2 is used for broadcast sessions. The applicability of delivery mode 2 to multicast sessions is not decided yet.

It should be helpful to decouple the concept of multicast/broadcast session from delivery mode. As such, the multicast sessions may be transmitted by delivery mode 1 or delivery mode 2, depending on the application-layer requirement for MBS service. Consequently, the multicast session that does not require high quality reception (lower QoS requirement) could be provided in the broadcast manner (i.e. delivery mode 2). This should be confirmed by RAN2.

### **Question 3**

Do you agree that delivery mode 2 can also support the transmission of multicast sessions?

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# Transmission of PTM configuration

## 3.1 PTM configuration transmitted by MCCH

The MBS PTM configuration can be configured via two-step based approach or one step based approach (as depicted by Figure 1) for delivery mode 2.

In LTE SC-PTM, the configuration is provided by two steps, i.e., SIB20 and SC-MCCH. SIB20 provides the SC-MCCH scheduling information; and SC-MCCH provides the SC-MTCH scheduling information. The SC-MCCH is scheduled by SC-RNTI at PDCCH and the SC-MTCH scheduled by G-RNTI at PDCCH. The two-step configuration offers the benefit that the PTM configuration scheduling is independent from SIB scheduling.

However, as discussed within email discussion [Post-111e][906], PTM configuration can also be provided by one step approach, i.e. at SIB. Some companies think that with this approach, the UEs can easily know what MBS services are provided by simply reading the MBS control information SIB without the need to monitoring MCCH.

RAN2 needs to decide the way for the transmission of PTM configuration for delivery mode 2 according to the discussion above.



*Figure 1: MBS configuration alternatives*

### **Question 4**

Do you agree that the two-step based approach (i.e. BCCH and MCCH) as adopted by LTE SC-PTM is reused for the transmission of PTM configuration for NR MBS delivery mode 2?

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## 3.2 Reception of PTM Configuration for connected UEs

This section assumes NR MBS delivery mode 2 supports both idle/inactive UEs and connected mode UEs, which depends on the confirmation of Question 1.

As discussed in the previous section, the PTM configuration for the MBS sessions supported by delivery mode 2 can be acquired on BCCH and/or MCCH. There may be no ambiguity for idle/inactive UEs. However it would be needed to clarify if the same principle also applies to connected mode UEs.

There are two alternatives according to the contributions submitted to RAN2#112e. At first alternative, the UEs in connected mode acquires the PTM MBS configuration from broadcast (BCCH and/or MCCH). At second alternative, the UEs in connected mode receives the MBS configuration via dedicated signaling. Note that LTE SC-PTM adopts the first alternative.

### **Question 5**

Select the alternative for connected UEs to receive the PTM Configuration for MBS services for NR MBS delivery mode 2?

Alt-1: Reuse LTE SC-PTM mechanism (i.e. receive the PTM configuration via broadcast)

Alt-2: Receive the PTM Configuration for MBS services via dedicated signaling

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## 3.3 Area specific MBS SIB and PTM configuration

As discussed in many contributions submitted to RAN2#112e, the MBS SIB and MCCH configuration may be area specific. If the MBS SIB and PTM configuration are area specific, the UE may not need to read the MBS SIB after cell reselection and then may help to ensure better service continuity. On the other hand, according to the view within the contributions, some company thinks that PTM configuration (e.g. in MCCH) should be cell specific as different cell may deliver different MBS services.

### **Question 6**

Do you agree that MBS SIB can be area specific for NR?

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### **Question 7**

Do you agree that the PTM configuration (e.g. in MCCH) can be area specific for NR MBS delivery mode 2?

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## 3.4 On-demand MCCH transmission/PTM configuration

As discussed in many contributions submitted to RAN2#112e, MCCH for NR MBS can be provided in on-demand mode following the similar principle of On-demand SI transmission as supported by NR Rel-15/Rel-16. For delay tolerant services, On-demand MCCH transmission may be able to optimize the resource consumption for MCCH signalling. On the other hand, it may be not friendly to delay sensitive services. In addition, On-demand MCCH transmission require the UE-Network interaction before the MBS service reception. In order to allow some flexibility, NR MCCH can be transmitted either by using Broadcast mode or on-demand following network configuration.

### **Question 8**

Select the alternative to support MCCH transmission/PTM configuration:

Alt-1: Reuse LTE SC-PTM mechanism (i.e. Broadcast mode based MCCH transmission)

Alt-2: NR MCCH/PTM configuration can be transmitted either by using Broadcast mode or on-demand following network configuration

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## 3.5 Multiple MCCHs within one cell

This discussion of this section assumes MCCH is adopted for PTM configuration transmission.

Legacy MCCH uses a fixed modification period and repetition period and one MCCH may not cater for different characteristics of use cases for NR MBS. One possibility would be to consider whether the configuration channel should be separated for different use cases. For example, one MCCH provides the delay sensitive services frequently while another MCCH provides the delay tolerant services sparsely.

In LTE SC-PTM, there was the restriction that one cell has only one SC-MCCH. However, NR MBS can remove such a restriction, considering a larger number of use cases are assumed than LTE. If the multiple MCCHs are allowed in a cell, each MCCH can have different scheduling configuration, such as the repetition period, which can be optimized for certain services.

In this case, the PTM configuration can be transmitted by multiple MCCHs within one cell and the UE can only receive the MCCH configuration about the services that he is interested in.

### **Question 9**

Do you agree that the PTM configuration can be transmitted by multiple MCCHs within one cell for NR MBS delivery mode 2?

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# Change notification for PTM configuration

## 4.1 Purpose of PTM change notification mechanism

It should be noted that the legacy change notification mechanism for MBMS (including eMTC/NB-IoT SC-PTM) was designed to notify the changes of (SC-)MCCH due to session start and the changes of (SC-)MCCH due to other purpose (e.g. modification of the transmission cycle, counting request for a service, etc.).

There is a view that from upper layer perspective, the broadcast session does not require session joining procedure for the UE before MBS service reception. If this is the case, NR delivery mode 2 may need not to support to notify the changes of PTM configuration (e.g. carried by MCCH) due to session start provided that only broadcast session is supported by NR delivery mode 2. This discussion may depend on the reply for Question 3 in section 2.3.

Meanwhile, rapporteur understanding is that NR delivery mode 2 need to support to notify the changes of PTM configuration due to other purposes (e.g. modification of the transmission cycle for a service).

RAN2 needs to confirm the above understandings.

### **Question 10**

Do you agree that the PTM change notification mechanism can be used to notify the changes of PTM configuration (e.g. carried by MCCH) due to session start for delivery mode 2 of NR MBS?

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### **Question 11**

Do you agree that the PTM change notification mechanism can be used to notify the changes of PTM configuration (e.g. carried by MCCH) due to other purpose (e.g. modification of the transmission cycle for a service) for delivery mode 2 of NR MBS?

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## 4.2 Baseline of PTM change notification mechanism

The discussion of PTM change notification should be connected with the decision whether two-step approach (BCCH +MCCH) or one-step approach (BCCH only) is adopted for PTM configuration transmission, as discussed within section 3.1. However, this discussion in this section assumes that MCCH logical channel is adopted for the transmission PTM configuration as LTE SC-PTM.

It should be noted that the initial discussion for change notification for MBS was taken during email discussion [Post-111e][906] for Idle/Inactive mode UEs. According to that email discussion summary and the contributions submitted to RAN2#112e, rapporteur understanding is that the companies want to have a baseline for change notification before any specific enhancement discussion.

**Baseline: Use the legacy LTE SC-PTM change notification mechanism**

In LTE SC-PTM, the change notification of the MBMS control information is sent in the first subframe in a Repetition Period where the SC-MCCH can be scheduled. The notification is sent using the DCI format 1C with SC-N-RNTI. When the UE receives the notification, it will acquire the updated SC-MCCH.

RAN2 needs to confirm this baseline for PTM change notification mechanism for NR MBS delivery mode 2.

### **Question 12**

Do you agree to use the legacy LTE SC-PTM change notification mechanism as the baseline for PTM change notification for delivery mode 2 of NR MBS?

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## 4.3 Group based PTM change notification

This section continue the discussion from previous section.

The legacy LTE SC-PTM change notification mechanism is a simple solution. However, as commented by some companies during the email discussion Post111-e(906), the SC-PTM change notification mechanism may lead the UE to monitor both MCCH and PCCH and to wake up and receive the updated MCCH control information for some MBS services which are not his interests and then may be not friendly to UE power consumption for the cases where PTM configuration changes too often.

According to the email discussion (Post111-e-906) summary [1] and the contributions submitted to RAN2#112e, rapporteur summarizes the following alternatives to handle the issue.

**Alternative 1: Multiple MCCHs to notify PTM configuration change**

The network groups some of MBS services together to form a MBS service group to share the same MCCH modification cycle and repetition cycle. For example, the frequently changed MBS services can be organized together into one service group and their PTM configuration and change notification shares one MCCH. As discussed in section 3.5, multiple MCCHs are used in this case.

If the MBS services could be grouped above, the PTM change notification can be only notified to the involved UEs which have interests. UE may refrain from frequent wake-up for MCCH check if he wants to only follow less frequently changed MBS services (e.g. IoT services).

**Alternative 2: Group based paging to notify PTM configuration change**

The spirit of this design is to merge the monitoring of PTM configuration change notification into the legacy paging monitoring to save UE power. The bits within the Short Message field of the legacy DCI format for paging or new DCI format can be used to indicate whether the NR MBS control information is changed. The field (e.g. short message) can further indicate which MBS service group’s MBMS control information are changed. The UE reads the paging and then reads the updated MCCH channel if needed.

This design also assume that the MBS services could be grouped. This design implies that the UE that is interested in the MBS services can be automatically grouped and then UE group based paging applies. It should be noted that UE group based paging is being discussed within Rel-17 power saving WI.

The benefit of this alternative is that the change notification is only notified to the involved UEs which have interests [28]. However the discussion of the DCI format may need coordination with RAN1. RAN2 also needs to discuss how to group the UEs to enable group based paging for different MBS service groups.

There may be pros and cons for the abovementioned alternatives. And there may be additional alternatives for the enhancement of baseline PTM change notification mechanism.

RAN2 can discuss which alternative should be adopted if an enhancement based on the baseline PTM change notification mechanism is considered.

### **Question 13**

Which alternative should be adopted if an enhancement based on the baseline PTM change notification mechanism is considered?

Alt-1: Multiple MCCHs to notify PTM configuration change

Alt-2: Group based paging to notify PTM configuration change

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# Counting and Interesting indication

In LTE eMBMS/SC-PTM, there are two different types of methods specified to collect UE’s receiving/interested services, i.e., MBMS Counting and MBMS Interest Indication (MII). RAN2 should discuss if the related mechanism can apply to delivery mode 2 of NR MBS.

## 5.1 Counting

In LTE eMBMS, counting is used to determine if there are sufficient UEs interested in receiving a service to enable the operator to decide if it is appropriate to deliver the service via MBSFN.

When the MCE entity requests the counting, MCE will send counting request to eNB. Upon reception of Counting Request from MCE, eNB will broadcast Counting Request to the UE, then the RRC\_CONNECTED UE will respond the counting response message to the network, in order to assist the network to decide the transmission method for the MBMS session. But for RRC\_IDLE UE, they are not mandated to enter RRC\_CONNECTED mode to respond the counting request.

For NR MBS delivery mode 2, even though there is no standardized support for MBSFN, the counting may still help to the network to decide the transmission method.

RAN2 needs to discuss the support of counting procedure for delivery mode 2 for both connected UEs and Idle/Inactive mode UEs.

Specific to Idle/Inactive mode UEs, some companies think that it would be possible to allow UE to respond the counting request without going to RRC connected mode if it is supported [4].

### **Question 14**

Should delivery mode 2 support counting procedure for connected mode UEs?

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### **Question 15**

Should delivery mode 2 support counting procedure for Idle/Inactive mode UEs?

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### **Question 16**

Should delivery mode 2 support counting procedure for Idle/Inactive mode UEs without mandating the UEs to enter RRC connected mode?

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## 5.2 Interesting indication

In LTE eMBMS/SC-PTM, the purpose of MBMS Interest Indication procedure is to inform E-UTRAN that the UE is receiving or is interested to receive MBMS via an MRB, and if so, to inform E-UTRAN about the priority of MBMS versus unicast reception.

As can be seen, the MBMS Interest Indication procedure is different from counting procedure. Furthermore, in LTE eMBMS/SC-PTM, UEs in RRC\_CONNECTED is allowed to send the MBMSInterestIndication message at any time. It contains the information related to MBMS frequencies of interest, MBMS services of interest, MBMS priority, etc. MBMS Interest Indication (MII) procedure is mainly used for the network to ensure that the UE can continue to receive its service of interest while in connected mode.

In LTE eMBMS/SC-PTM, MII cannot collect the information from UEs in IDLE mode, even though the majority of UEs may receive the broadcast services in IDLE mode.

According to the email discussion [Post111-e][906] and company contribution submitted to RAN2#112e, some companies think that unnecessary PTM transmissions can be avoided if the cell knows the interests of UEs in IDLE/INACTIVE. However, some companies have concerns about the complexity and signalling overhead of UE interest indication from UE in idle/inactive mode.

For NR MBS delivery mode 2, there may be both connected UEs and Idle/Inactive mode UEs. So then RAN2 can separate the discussion for connected UEs and Idle/Inactive mode UEs.

### **Question 17**

Should MBS Interest Indication is supported for UEs in connected mode for delivery mode 2?

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### **Question 18**

Should MBS Interest Indication is supported for UEs in idle/inactive mode for delivery mode 2?

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## 5.3 Interaction between MBS interest indication and On-Demand SI

There is a discussion at the previous section (i.e. 3.4) on the support on-demand PTM configuration (as provided by e.g. MCCH). Then there is a proposal to correlate the procedure of MBS interest indication with on-demand request for MCCH configuration [19]. In practice, the UE can provide an MBMS interest indication as part of the process to acquire an MBS SIB or PTM configuration (e.g. carried by MCCH). Requesting MBS SIB/PTM configuration could be understood as some form of MBS interest from the UE. This can be seen as a signalling optimization to reduce latency.

### **Question 19**

Should MBS Interest Indication be merged with on demand MBS/PTM configuration request procedure for delivery mode 2?

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# Service continuity for Delivery mode 2

## 6.1 Need of Service continuity for Delivery mode 2

The need of service continuity for Delivery mode 2 should be discussed. On one hand, the Delivery mode 2 is used for low QoS MBS service and then the service continuity for UE reception may be not very critical. On the other hand, the current service continuity mechanism for LTE SC-PTM/eMBMS is easy to be reused by Delivery mode 2. RAN2 can confirm the understanding before any other discussion for service continuity for Delivery mode 2 in the following sections.

### **Question 20**

Do you agree that service continuity is needed for NR MBS Delivery mode 2?

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## 6.2 Mechanism to transmit the information for Service continuity for Delivery mode 2

For LTE SC-PTM, the service continuity was ensured via various ways as described below:

At first, to avoid the need for the UE to read MBMS related system information and potentially SC-MCCH on neighbor frequencies, the MBMS assistance information are provided by both USD (i.e. user service description) and system information (i.e. SIB15).

Secondly, the UEs in RRC\_IDLE applies frequency based prioritization during cell reselection.

Thirdly, for each MBMS service provided using SC-PTM, E-UTRAN indicates in the SC-MCCH the list of neighbor cells providing this MBMS service so that the UE can request unicast reception of the service before changing to a cell not providing the MBMS service using SC-PTM. The UEs in RRC\_CONNECTED informs the network about its MBMS interest, and then the network does its best to ensure that the UE is able to receive MBMS and unicast services subject to the UE’s capabilities during mobility.

Specific to NR delivery mode 2, this section can focus on the discussion of first way as mentioned above. The discussion of frequency based prioritization is taken at section 6.3 and 6.4. The discussion of the third way (i.e. interest indication and MCCH information) is taken at section 5 and section 7 respectively.

RAN2 needs to decide whether NR delivery mode 2 can assume that both USD and system information can be provided for purpose of service continuity as for LTE SC-PTM. It should be noted that USD will be discussed by SA/CT WGs and the design of the content of system information may be subject to the final description of USD.

### **Question 21**

Do you agree that both USD and system information can be provided for purpose of service continuity for NR MBS Delivery mode 2 (i.e. reuse legacy approach for LTE SC-PTM)?

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## 6.3 UE awareness of MBS services on cell/frequency basis for service continuity

In LTE, the MBMS service is deployed on frequency basis, and the mechanism specified to ensure UE service continuity is that, UE is made aware of which frequency is providing which MBMS services through the combination of USD and SIB15.

During the email discussion [Post-111e][906], there are diverse views on the reuse of the same mechanism as LTE SC-PTM. For example, some companies think that the MBS service information only for neighboring frequencies may not be enough and show preference to have a cell list per frequency per MBS service or a list about the services the cell/node could support (e.g. via BCCH). However this requires more configuration and maintenance of system information to provide neighbor cell info per cell. RAN2 need to discuss this issue from the perspective of delivery mode 2.

### **Question 22**

Select the alternative to support UE awareness of MBS services on cell/frequency basis for service continuity for NR MBS delivery mode 2?

Alt-1: Reuse LTE SC-PTM mechanism (i.e. per frequency)

Alt-2: Support cell based neighbor cell info for MBS service

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## 6.4 Frequency/cell prioritization for service continuity

In LTE, specific to the MBMS service, UE can determine whether to make the frequency which also provides current MBS service(s) a highest priority during the evaluation of cell reselection. However, if the specific MBS service is deployed on a cell basis, some interested MBS services may be only supported by a certain cell of a particular frequency. Then there may be no motivation to prioritize that frequency if the signal strength of that cell supporting the MBS services is not strong enough.

### **Question 23**

Select the alternative to support cell/frequency prioritization during cell reselection for service continuity for NR MBS delivery mode 2?

Alt-1: Reuse LTE SC-PTM mechanism (i.e. per frequency)

Alt-2: Support cell based prioritization for MBS service

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# Content of PTM configuration

Furthermore, it should be clarified what kind of information the PTM configuration carries (e.g. by MCCH if supported). In LTE SC-PTM, the *SCPTMConfiguration* message carries information about:

* The configuration of each SC-MTCH in the current cell (including MBMS session info, G-RNTI, SC-MTCH scheduling info).
* List of neighbour cells providing MBMS services via SC-MRB.

Note that the first part of the information above for the configuration of the MBS service and the second part of the information is for the purpose of service continuity as discussed in section 6.2.

Correspondingly, for NR MBS delivery mode 2, PTM configuration can include the following information:

* The configuration of each MTCH in the current cell (including MBS session info, G-RNTI and MTCH scheduling info).
* List of neighbour cells providing MBS services via NR MBS delivery mode 2.

### **Question 24**

Do you agree that for NR MBS delivery mode 2, PTM configuration can include the following information?

* The configuration of each MTCH in the current cell (including MBS session info, G-RNTI and MTCH scheduling info).
* List of neighbour cells providing MBS services via NR MBS delivery mode 2.

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| Company | Yes/No | Comments |
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# Conclusion

The following proposals are made based on the email discussion:

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