**3GPP TSG-RAN WG2 Meeting #116bis-e R2-2201706**

Online, 17 – 25 January 2022

**Agenda item: 8.3.3**

**Source: vivo**

**Title: [****AT116bis-e][231][MUSIM] MUSIM gap details**

**WID: LTE\_NR\_MUSIM-Core**

**Document for: Discussion and Decision**

# Introduction

This document is the summary of the following email discussion:

* [AT116bis-e][231][MUSIM] MUSIM gap details (vivo)

Scope: Discuss the details of MUSIM gaps for the NW switching when UE does NOT leave RRC connection: 1) is there a need to define new MGL or MGRP for MUSIM purposes, or are the existing MGL/MGRP sufficient? 2) how to define the details of gap signalling (UE assistance + NW configuration) 3) are there any urgent RAN2 actions needed based on the RAN4 LS R2-2200132 (e.g. reply LS)

Deadline: Thursday W1, 0500 UTC (Deadline 2)

Deadline 2 (discussions for Fri online):

* Comment deadline, 1st phase: Thursday W1, 0500 UTC (for collecting views)
* Rapporteur proposals, 1st phase: Thursday W1, 2000 UTC (proposed resolution of issues)
* Document deadline, 1st phase: Friday W1, 0500 UTC (report, agreed CRs,final approved LS, etc.)

# Discussion

To make it easier to find the correct contact delegate in each company for potential follow-up questions, the rapporteur encourages the delegates who provide input to provide their contact information in this table:

|  |  |
| --- | --- |
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## The needed MUSIM Gap

RAN#94e[1] has agreed that “*RAN4 is requested to capture in TS38.133 that legacy measurement gap patterns (as defined in TS 38.133 Table 9.1.2-1, and also including patterns #24 and #25) can be applicable for MUSIM operation and also to capture new gap patterns for MUSIM with MGRP equal to paging DRX cycles for IDLE/INACTIVE.*”

We would like to discuss the supported gap patterns for MUSIM.

### **Supported periodic gap**

Contributions [5][6][7][8][9][10][11] mentioned the measurement gap patterns for MUSIM.

* All legacy measurement gap patterns, including #24 and #25, are applicable to MUSIM [5][6][8][9][11]
* Introduce new gap periodicities to match paging cycles.[5][6][8][9][10][11]
* Longer gap durations may be introduced if needed.[6]

Since all legacy measurement gap patterns and new gap periodicities{320ms, 640ms, 1280ms, 2560ms } are applicable to MUSIM, as [7] proposed, RAN2 could capture the following values in UAI and RRC reconfiguration for MUSIM gap:

* MGL: 1.5ms, 3ms, 3.5ms, 4ms, 5.5ms, 6ms, 10ms, 20ms
* MGRP: 20ms, 40ms, 80ms, 160ms, 320ms, 640ms, 1280ms, 2560ms.

Companies are invited to express their view on the following question.

1. **Whether the following MGL/MGRP values are applicable for MUSIM periodic gap:**

* **MGL: 1.5ms, 3ms, 3.5ms, 4ms, 5.5ms, 6ms, 10ms, 20ms**
* **MGRP: 20ms, 40ms, 80ms, 160ms, 320ms, 640ms, 1280ms, 2560ms.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes | Based on RAN#94e[1] agreement, it’s fine to capture applicable MGL/MGRP values for MUSIM in TS38.331.  It’s worth noticing that, the final applicable gap patterns need to be captured in TS38.133, including new gap patterns for MUSIM with MGRP equal to paging DRX cycles for IDLE/INACTIVE*.* |
| OPPO | Yes | This proposal is aligned with RAN4 agreements, so we support. |
| Spreadtrum | Yes | Aligned with RAN4 agreements, so we support. |
| Ericsson | Wait for RAN4 | Our understanding is that RAN4 is also discussing this, so we should wait for RAN4 conclusion. We should not jump in RAN2 to conclusion that would raise more work in RAN4 on this at this point. |
| Huawei/HiSilicon | Yes | Agree with Vivo |
| NEC | Yes |  |
| Nokia | Yes. But | If number of periodic gaps are restricted to 2, the gap for paging reception should consider SSB reception for synchronization before paging search space monitoring. Whether this can fit within 20 msec to be confirmed with RAN4. |
| ZTE | Yes | Agree with Vivo |
| Lenovo | Yes |  |
| MediaTek | Yes, but | We may also have to wait RAN4 for finial conclusion |
| Samsung | Yes |  |
| Charter Communications | Yes | But perhaps need to wait for RAN4 outcome after their first meeting on this WI. |
| Intel | Yes | The current gaps can be re-used also for MUSIM but wait for RAN4 input. |
| Apple | Yes | Agree with Vivo |

**Summary:**

TBD.

### **Supported aperiodic gap**

Contributions [5][8][9][10] mentioned that aperiodic gap patterns are introduced for MUSIM purposes to cover Scenario 2 and Scenario 3.

[8] pointed out that, for aperiodic MUSIM gap, at least the MGL of legacy gap (i.e. R15/R16 gap) can be reused. It’s up to RAN4 to decide whether additional gap length should be introduced for aperiodic MUSIM gap. Contributions [5][9] proposed that an aperiodic gap with length of 20ms can be configured for aperiodic (one-shot) switching.

In LS[2], RAN4 concludes that an aperiodic gap pattern can fulfill the task of MIB/SIB1 reading. For the question “What would be the feasible range of value(s) for gap cycle and duration that can allow the UE to stay in Connected mode in Network A for all 3 scenarios?” RAN4 concludes that at least no problem is identified in case legacy MGL and MGRP are used.

Therefore, the legacy MGL, i.e. {1.5ms, 3ms, 3.5ms, 4ms, 5.5ms, 6ms, 10ms, 20ms}, can be reused for MUSIM aperiodic gap.

Companies are invited to express their view on the following question.

1. **Whether the legacy MGL {1.5ms, 3ms, 3.5ms, 4ms, 5.5ms, 6ms, 10ms, 20ms} is applicable for MUSIM aperiodic gaps?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes | It’s fine to capture legacy MGL value for aperiodic MUSIM gap in TS38.331.  Whether extra MGL values for MUSIM aperiodic gaps need to be introduced is up to RAN4*.* |
| OPPO | Yes | This proposal is aligned with RAN4 agreements, so we support. |
| Spreadtrum | Yes | Aligned with RAN4 agreements, so we support. |
| Ericsson | Wait for RAN4 | Our understanding is that RAN4 is also discussing this, so we should wait for RAN4 conclusion. We should not jump in RAN2 to conclusion that would raise more work in RAN4 on this at this point. |
| Huawei/HiSilicon | Yes | Based on the reply LS from RAN4, legacy gap pattern with legacy MGL can be used. |
| NEC | Yes |  |
| Nokia | No | Aperiodic gaps are also needed for short signalling procedures like BUSY indication. Here RACH procedure and short time in connected mode will be required. RAN2 has already agreed that whether UE can have RRC connection during aperiodic gap is left to UE implementation. For BUSY indication if the UE is capable of completing this procedure, this duration is not sufficient. |
| ZTE | Yes (but prefer to wait for RAN4) | On this topic, we general agree, but we think we should wait for RAN4’s conclusion. |
| Lenovo | Yes |  |
| MediaTek | Yes, but | We may also have to wait RAN4 for finial conclusion |
| Samsung | Yes |  |
| Charter Communications | Wait for RAN4 | Need to wait for RAN4. Applicability of shorter MGLs for aperiodic gaps is not certain. |
| Intel | FFS – wait for RAN4 | Aperiodic gaps are one-off gaps and they also need to support longer gap lengths for longer tasks in PLMN-B – so these are not sufficient. The benefit of re-using these gap lengths from RAN4 perspective for aperiodic gap should be discussed in RAN4. |
| Apple | Yes – Wait for RAN4 | We have to wait for RAN4 conclusion on this. |

**Summary:**

TBD.

### **Signalling supports more periodic and aperiodic gaps for MUSIM or not**

In RAN2#115e agreement, “*Only a single aperiodic gap (for MUSIM) is supported in Rel-17. At most two periodic “gaps” (for MUSIM) and a single aperiodic gap (for MUSIM) is supported in Rel-17. FFS if signalling supports more.*”

Contributions [5][6][10][11][12][13] mentioned the support of more than three gaps for MUSIM purposes in R17.

* Maximum periodic measurement gaps should not be limited to 2. [10][11]
* More than two periodic gap patterns should be supported. Using a single periodic gap configuration for paging reception will not be optimal when the SSB and PO are not in close proximity [6].
* More than 3 MUSIM gap configurations with active MUSIM gaps limited to 3 at the same time.[12]
* No extra work is needed to allow signalling supports more periodic and aperiodic gaps for MUSIM. Using gap list could support more gaps. This method is futureproofed. [5]

Contribution [7] proposed that signalling framework to support more than 3 gap patterns is not supported.

Companies are invited to express their view on the following question.

1. **Whether signalling supports more than three gaps for periodic and aperiodic gaps for MUSIM?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes | Supporting more gaps is flexible for UE and NW to configure suitable gaps for specific scenarios with better gap efficiency, e.g. PO and SSB are not in close proximity or several gaps are needed for SI reception etc.  Signaling could support more than three gaps for periodic and aperiodic gaps for MUSIM. If gap list is used as running CR does, it’s futureproofed and no extra work is needed.  Maximum periodic gaps should be at least 4 to allow further extension. |
| OPPO |  | No strong view if no extra spec effort is needed. |
| Spreadtrum |  | It depends on RAN4. |
| Ericsson | No | We should stick with what so far agreed by RAN4. If further input is received, we can of course consider more gaps. Otherwise, we should keep the current agreement on 3 gaps. |
| Huawei/HiSilicon | No | Based on the reply LS from RAN4, RAN4 did not identify the need to support signaling framework of more than 3 gap patterns. |
| NEC | No | More than 3 active gaps only for MUSIM purpose are more complicated than necessary in reality from network operation point of view.  We prefer to stick to current agreement to keep at most 3 gaps. |
| Nokia | Yes | It is better to define separate gaps for the cases specified in RAN4. There are 3 cases indicated in RAN4 response. If some gaps are combined it will require larger gap length than current MGL. This will require RAN4 confirmation again. Furthermore, combined gaps will remove the necessary flexibility for e.g. no. of SSBs needed for synchronization prior to paging monitoring. |
| ZTE | No | We share the view from Ericsson, and it may also depend on concurrent gap discussion. We’d better to wait for RAN4’s further confirmation about the aperiodic gap and also wait for some further progress on the concurrent gap |
| Lenovo | No | We need to keep the current agreement unless we have new motivation. |
| MediaTek | No | We also prefer to keep previous agreement that at most 3 gap is supported. It is always possible to extend the RRC signaling. ASN.1 details could be discussed based on CR. |
| Samsung | Yes | We think that it is better to support more than three gaps from signaling purpose for future enhancements, especially since there are limitations seen with current maximum of three gaps. |
| Charter Communications | Yes |  |
| Intel | No (but wait for further input from RAN4) | While this could be OK from RAN2 perspective, this should be discussed also in RAN4 and in the wider context of MGE. |
| Apple | Yes | From signalling aspect it should be ok, but prefer to wait for RAN4 input on this. |

**Summary:**

TBD.

## MUSIM assistance information

### **Configuration of UAI Reporting**

This is covered by email discussion [AT116bis-e][232][MUSIM] MUSIM configured time for leaving RRC connection.

### **Gap preference**

In RAN2#115e agreement, “*The switching gap configuration will explicitly provide the gap starting position (e.g. offset value or start SFN and subframe explicitly), gap length and gap repetition period.*”. In TS38.331 running CR[3], it’s an open issue how the gap offset is provided for periodic and aperiodic gaps in gap preference.

Contribution [5] mentioned below two potential options:

Option-1 : One field *musim-GapOffset-r17* for both periodic and aperiodic gap, as in [4]

MUSIM-GapInfo-r17 ::= SEQUENCE {

musim-GapOffset-r17 ENUMERATED {FFS},

musim-GapLength-r17 ENUMERATED {FFS},

musim-GapRepetitionPeriod-r17 ENUMERATED {FFS} OPTIONAL,

...

}

Option-2: offset value for periodic gap, start SFN and subframe for aperiodic gap

MUSIM-GapInfo-r17 ::= SEQUENCE {

musim-Starting-SFN-AndSubframe-r17 MUSIM-Starting-SFN-AndSubframe-r17 OPTIONAL, -- Cond aperiodic

musim-GapLength-r17 ENUMERATED {FFS},

musim-GapRepetitionAndOffset-r17 CHOICE {FFS} OPTIONAL -- Cond periodic

}

MUSIM-Starting-SFN-AndSubframe-r17 ::= SEQUENCE {

starting-SFN-r17 INTEGER (0..1023),

startingSubframe-r17 INTEGER (0..9)

}

Companies are invited to express their view on the following question.

1. **How UE provides gap repetition and offset for MUSIM gaps?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Options (1, 2)** | **Comments** |
| vivo | Option-2 | First, Option-1 has a common gap offset field for both periodic and aperiodic gap, then the size of this gap offset field should at least be enough to explicitly indicate the start SFN and subframe for aperiodic gap, which is a waste for periodic gaps.  Second, option-2 guarantees via ASN.1 coding that the gap offset is within the corresponding scope of Gap Repetition, which cannot be supported by option-1.  Therefore, we support option-2 |
| OPPO | Option2 | Option2 is more clear from our side. |
| Spreadtrum | Option2, but comments | Option 2 is simple, if the start point could be predicted in advance. |
| Ericsson | Option-2 | We are fine to go with option 2. |
| Huawei/HiSilicon | Option-2 | Agree with Vivo. |
| NEC | Option 2 | Agree with vivo that if using offset to indicate the starting point of aperiodic gaps, the field of offset should be very large, so we prefer Option 2. |
| Nokia | Option 3 (New parameter needed based on RAN4 response) | As per RAN4 discussions, if the MUSIM gap and MG are overlapping MG of NW-A will be used for NW-A operation. This will lead to impacting the MUSIM operation if the gap is meant for paging reception. So the assistance information should include parameter “Gap-Priority” in Gap-info so that network may choose to reconfigure MG not to overlap with this. |
| ZTE | Option-2 | Agree with Vivo. |
| Lenovo | Option 2 |  |
| MediaTek | Option 2 | We are fine with option 2 |
| Samsung | See comments | We think that existing definition in RRC running CR can be reused, by following modifications.  With respect to the start subframe for aperiodic MUSIM gap, there seems no real need to define separate field but to restrict the value of musim-GapOffset from 0 to 9 in the field description.  MUSIM-GapInfo-r17 ::= SEQUENCE {  musim-GapOffset-r17 ENUMERATED {FFS},  musim-GapLength-r17 ENUMERATED {FFS},  musim-GapRepetitionPeriod-r17 ENUMERATED {FFS} OPTIONAL -- Cond periodic,  musim-GapStartSFN ENUMERATED {FFS} OPTIONAL -- Cond aperiodic,  ...  } |
| Charter Communications | Option 2 |  |
| Intel |  | The gap details has to be discussed first in RAN4 and on what parameters are needed for aperiodic gaps and whether there is real need to perfectly synchronise the network and UE for aperiodic gaps considering it could be much longer gap length. |
| Apple | Option 2 |  |

**Summary:**

TBD.

### **UE indicates the release of gap pattern**

Contributions [5][6][7][9][19][20][21][22][23][24][25[26] mentioned the ways for UE to indicate the release of the gap pattern(s).

Indicate the release of gap preference:

Option-1: If the *UEAssistanceInformation* does not include a field for aperiodic or periodic gap preference, it indicates no preference for the corresponding field for aperiodic or periodic gap. [5][6][7][9][19][20]

Option-2: Use a size 0 list for *MUSIM-GapRequestList-r17* to indicate the release of gap request.[21]

Indicate the release of configured gap(s):

Option-3: Each MUSIM gap configured by network A is associated with an index, UE can indicate which MUSIM gap should be released by including the corresponding MUSIM gap index into *UEAssistanceInformation* Msg.[8][25][26]

Therefore, UE could either indicate the release of gap preference(option 1, 2) or indicate the release of configured gap (option 3) with *UEAssistanceInformation*.

Companies are invited to express their view on the following question.

1. **How does UE request to release MUSIM gap pattern?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Options (1, 2, 3)** | **Comments** |
| vivo | Option-1 | If UE wants to release a configured gap, UE should firstly release the corresponding gap preference. Then the network could know the configured gap corresponding to the released gap preference is not needed any longer. Hence, UE doesn’t have to indicate the release of configured gaps to the network.  To release a configured gap for MUSIM, the UE can send a *UEAssistanceInformation* without the preference information related to the configured gap to be released |
| OPPO | Option3 | UE MUSIM gap modification/release procedure is simpler and flexible, i.e. there is no need to add the previously requested MUSIM gap (if still needed by UE) into UAI message again even if the intention of the latest UAI message is to request new MUSIM gap and/or release part of the configured MUSIM gap. |
| Spreadtrum | Option 3 | For option3, the size of RRC message is small. |
| Ericsson | Option-1 | We think this is cleaner and how usually done to other fields in UE assistance information. Hence, a deviation from this principle, in case really needed, should be further motivated. We don’t think there is any size constraint with the RRC message for UAI case. Furthermore, it actually makes it more complex to create dependencies between a previous UE report and the current report, so we think it is actually simpler if the UE just sends all its preferences in every report. |
| Huawei/HiSilicon | Option-1 | Similar view as Vivo. Option-1 is simpler and aligned with other UAI procedures. There is no need to define size 0. |
| NEC | Option 1 | Agree with vivo. Option 1 is aligned with the other assistance information in UAI. |
| Nokia | Option 3 | Sperate field to indicate the configured gap index to be released is preferred |
| ZTE | Option-1 | Share the view as Ericsson |
| Lenovo | See comments | We assume this question is associated with releasing all configured gaps. In option1, the UE can transmit the UEassistanceinformation without gap request. according to the ASN.1 design,  But the preferred state can be set as connected, which can explicitly indicate to network to stay at connected. MUSIM-Assistance-r17 will not be included. That means network receives the UAI without MUSIM information. How to deduce the UE wants to release all gaps?  MUSIM-Assistance-r17 ::= SEQUENCE {  musim-PreferredRRC-State-r17 ENUMERATED {IDLE, INACTIVE} OPTIONAL,  musim-GapRequestList-r17 MUSIM-GapRequestList-r17 OPTIONAL,  ...  }  MUSIM-GapRequestList-r17 ::= SEQUENCE (SIZE (1..3)) OF MUSIM-GapInfo-r17  MUSIM-GapInfo-r17 ::= SEQUENCE {  musim-GapOffset-r17 ENUMERATED {FFS},  musim-GapLength-r17 ENUMERATED {FFS},  musim-GapRepetitionPeriod-r17 ENUMERATED {FFS} OPTIONAL,  ...  } |
| MediaTek | Option 1 | Same principle as other UE assistance information is preferred |
| Samsung | Option 1a:  Option 1 only for periodic gaps. Aperiodic gaps can be implicitly released. | We propose to have a modified option 1- option 1a where option 1 is applied for periodic gaps, and aperiodic gaps are implicitly released without any UAI procedure. Option 1 is simpler and aligned with other UE assistance features for the release of periodic gaps. Since both UE and network know aperiodic gap is not used/needed anymore, UE needn’t trigger UAI procedure for release of aperiodic gaps and an aperiodic gap can be implicitly released once the configured gap period is over. |
| Charter Communications | Option 3 |  |
| Intel | Option 2 (or option 1) | We don’t see a big difference between option 1 and 2 – in both cases, the UE providing MUSIM UAI without a requested gap pattern indicates that UE no longer needs gaps. They are both based on the principle that whenever UE sends a UAI for MUSIM gap, UE will always request all the gaps needed and there is no delta signalling. |
| Apple | Option 3 | Using the gap index in straight forward and keeps the signaling compact. |

**Summary:**

TBD.

### **MUSIM UAI update**

In RAN2#116e agreements, one open issue is “*FFS if UE is allowed to update UAI message after the UE performs cell reselection in NW B or after the UE performs handover in NW A*”. In the rapporteur’s understanding, the open issue is whether UE is allowed to update UAI message upon UE finishes cell reselection in NW B or handover in NW A, without the prohibit timer’s restriction.

Contributions [5][7][8][9][19][20][21][24][27] [28] mentioned the update of UAI message after the UE performs cell reselection in NW B or after the UE performs handover in NW A.

The proposals from the proponents are following:

* UE is allowed to update MUSIM UAI message. [5][24]
* UE is not allowed to resend the previous MUSIM UAI message in the same serving cell[5][27]
* UE is allowed to update the gap pattern by resending the UAI message after the UE performs cell reselection in NW B or after the UE performs handover in NW A [7]
* The attributes of previously-negotiated gaps may be revised by the UE due to cell reselection on NW B, in order to efficiently utilize the gap. Hence, RAN2 should avoid network-imposed restrictions.[11]
* After performing a handover in Network A, the UE is allowed to send an UEAssistanceInformation with MUSIM preference. [7][9][28].

The reason from the Opponent is following:

* There is no update of UEAssistanceInformation message including gap preference after performing cell reselection in Network B. [9]

And some companies think the issue can be left to UE implementaion:

* It’s up to UE implementation whether to update MUSIM gap configuration in network A after cell reselection in network B, i.e. no spec effort is needed from RAN2 perspective[8]
* The triggers for when the UE can request new MUSIM gap patterns are not specified and are left to the UE implementation[6]

In addition, contributions [5] [9][19][20][21] mentioned whether prohibit timer is used for switching notification message sending.

* Prohibit timer is Not used for switching notification message sending [5][21]
  + The prohibit timer may result in a long delay to send out updated gap preference after cell reselection in NW B, which may cause paging missing.[5]
* Introduce a prohibit timer.[9][19][20]
  + prohibit timer is used other assistance information within UEAssistanceInformation message to avoid frequent transmission of assistance information to the network.[20]

In the rapporteur’s understanding, the above two issues are related. If prohibit timer is used for switching notification message sending, UE could not update UAI for MUSIM gap preference upon UE finishes cell reselection in NW B if the prohibit timer is running. Paging message from network B could be lost if the configured MUSIM gap doesn’t overlap with the PO to be monitored in the new camping cell. If prohibit timer is not used, and UE could update UAI message whenever necessary, e.g. after the UE performs cell reselection in NW B or after the UE performs handover in NW A. But some mechanisms are needed to prohibit frequent UAI sending from UE.

There could be two potential proposals:

Option-1: **UE is allowed to send MUSIM UAI message whenever necessary. But UE is not allowed to repeat the last MUSIM UAI message in the same serving cell.**

Option-2: **Introduce a prohibit timer, UAI message could not be triggered for MUSIM purposes when the timer is running**

Companies are invited to express their view on the following question.

1. **On UAI update for MUSIM gap preference, which option do you prefer?**

**Option-1: UE is allowed to send MUSIM UAI message whenever necessary. But UE is not allowed to repeat the last MUSIM UAI message in the same serving cell.**

**Option-2: Introduce a prohibit timer, UAI message could not be triggered for MUSIM purposes when the timer is running**

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| --- | --- | --- |
| **Company** | **Options (1, 2)** | **Comments** |
| vivo | Option-1 | For MUSIM, The prohibit timer may delay gap preference update after cell reselection in NW B, which may cause paging missing. Therefore, we propose that no prohibit timer is used for MUSM assistance info.  UE should be allowed to update UAI message whenever necessary, e.g. after the UE performs cell reselection in NW B or after the UE performs handover in NW A. And, UE is not allowed to repeat the last MUSM assistance info reported in the same serving cell to avoid frequent UAI sending. |
| OPPO | Option1 with comments | Generally, we agree the comments from vivo, but also think the sentence ‘**But UE is not allowed to repeat the last MUSIM UAI message in the same serving cell**’ should be removed from option1, a good UE implementation will never repeat the last MUSIM UAI message in the same serving cell if no change happens in network B, so we prefer to revise option1 into the following:  **Option1: It’s up to UE implementation whether to update MUSIM gap configuration in network A after cell reselection in network B, i.e. no spec effort is needed from RAN2 perspective.**  The revised option1 is more clear from our side. |
| Spreadtrum | Option 1 | The update of UAI shall not be restricted, because the UAI updation depends on the other network. |
| Ericsson | Option-2 | Note a prohibit timer is a general handling adopted for messages in UE assistance info to avoid frequent reporting, together with the requirement for the UE to send a different indication from the one sent previously. Hence, if a prohibit timer is not introduced, RAN2 should discuss other means to avoid frequent reporting. |
| Huawei/HiSilicon | Option-2 with suggestions | Option-1 allows UE to update UAI whenever necessary. This kind of mechanism should be avoided as the UE behavior is untestable/uncontrollable. Normally too much flexible behavior in the spec should be avoided as it’s very difficult for the NW to adapt with frequent GAP requests from the UE (e.g.: a UE with bad implementation may repeatedly attempt different GAP configurations in a short time) and will have negative impact on scheduling policy of the NW.  So we prefer Option-2 to be aligned with other UAI procedures with the possibility for the UE to update UAI for gap preference upon cell reselection in NW B or HO in NW A even if the prohibit timer is running. MUSIM gap configuration case is different from overheating. If the cell reselection or HO results in unsuitable gap and if the gap is not updated in time, resource waste/data loss will happen for a long time. So it’s necessary to allow the UE to update UAI upon cell reselection in NW B or HO in NW A even if the prohibit timer is running.  As Ericsson commented, if prohibit timer is not introduced, RAN2 need to discuss methods to avoid frequent reporting. For example, specifying exact UAI conditions like cell reselection in NW B or HO in NW A. |
| NEC | Option 2 | Prohibit timer is used by the network to control frequent request from the UE. We prefer to reuse this to give network A the right to control the frequency of scheduling gap request for service of network B. If network A really cares about the delay of paging reception of network B, network A can configuring the prohibit timer value as 0.  BTW, for Option 1, since UAI is triggered in the same serving only upon change of preferred gap information, “UE is not allowed to repeat the last MUSIM UAI message in the same serving cell” is not clear to us. |
| Nokia | Option 1 | As the trigger condition of UAI is not specified we need not restrict about the repetition. It can be left to UE implementation. |
| ZTE |  | We slightly prefer option 1 but we also see the concerns from the companies who support option 2, e.g. the UE may modify the gap info and send the UAI frequently even there is no new event triggered. If there is no other mechanism that can prevent UE from frequently reporting UAI, the prohibit timer shall be introduced. |
| Lenovo | Option 1 | Option is legacy. |
| MediaTek | Option 2, but | The maximum prohibit timer should be limited to a reasonable value. |
| Samsung | Option 2 | We think that network should have a means (e.g. prohibit timer) to control frequent MUSIM assistance information reports alike other UE assistance features. The value range of prohibit timer for UAI is in general in order of seconds so appropriate value range can be further discussed to avoid any side effects. |
| Charter Communications | Option 1 |  |
| Intel | Option 1 | We don’t think a prohibit timer should be used. The UE should be allowed to send UAI whenever needed based on the requirements for PLMN-B that could change at any time, due to cell reselection in PLMN-B, RF changes etc.  If a badly implemented UE repeats UAI too often, network can disable MUSIM UAI for this UE. |
| Apple | Option 1 | Because UAI usage trigger is based on the other NW |

**Summary:**

TBD.

x

Contributions [5] [19] [20][21] proposed that UE is allowed to initiate UAI message with MUSIM preference in the target cell after handover if the UE has sent UAI during the last 1 second.

In the legacy UAI framework, UE is allowed to initiate a UAI message in the target cell after handover, if the UE has sent UAI during the last 1 second.

Companies are invited to express their view on the following question.

1. **Whether UE is allowed to initiate a UAI message with MUSIM preference in the target cell after handover, if the UE has sent UAI during the last 1 second?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes | The source cell may fail to receive the latest UAI with MUSIM preference before/during handover and cannot send the latest UAI to the target cell.  To resolve this issue, a simple way is to allow UE to initiate a UAI message with MUSIM preference in the target cell after the UE performs handover in NW A, as the legacy UAI framework does. |
| OPPO | Yes | Fine to reuse the legacy UE behavior defined for UAI. |
| Spreadtrum | Yes |  |
| Ericsson | Yes | Similar view as Vivo. |
| Huawei/HiSilicon | Yes | Agree with Vivo. |
| NEC | Yes | Agree to reuse the legacy behaviour for scheduling gap request. |
| Nokia | Yes | We don’t see reason to restrict this. If the received configuration after handover already has gap configurations, UE need not trigger again. But it is upto UE to decide on sending it after handover. |
| ZTE |  | We think it depends on whether the target cell has included the proper Gap configuration in the handover message. If included there is no need to send UAI again, otherwise, we think it should be allowed. |
| Lenovo | Yes | It is normal UAI issue rather than MUSIM specific issue. |
| MediaTek |  | We can follow the general UAI resending rule during handover |
| Samsung | Yes | Prefer to reuse the legacy behaviour |
| Charter Communications | Yes |  |
| Intel | Yes | Legacy behaviour is required for MUSIM UAI as well. |
| Apple | Yes | Legacy behaviour needs to be maintained for such cases |

**Summary:**

TBD.

## Gap Configuration

Contributions [5][26][27] mentioned whether adopt the list with ToAddModList/ToReleaseList for the scheduling gap configuration.

* Adopt the list with ToAddModList/ToReleaseList for the scheduling gap configuration. [5][27]
* Introduces addition/modification and release list for multiple gap handling.[26]

Furthermore, gap ID is proposed in [5][25][26] to identify each configured gap.

* Each MUSIM gap configured by network A is associated with an index, to support modification or release of gaps.[5]
* NW and UE can uniquely identify each configured gap pattern with a unique gap ID specific to the UE. [25]
* RAN2 introduces gap ID for multiple gap handling.[26]

[22] suggests that, nevertheless gap ID is configured for periodic gap pattern or not, the gap ID is not needed for the aperiodic gap pattern.

Companies are invited to express their view on the following question.

1. **Whether adopt the list with ToAddModList/ToReleaseList for the scheduling gap configuration?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes | Network may modify or release the configured gaps. In order to facilitate the gap reconfiguration, we propose to adopt the list with ToAddModList/ToReleaseList for the scheduling gap configuration |
| OPPO | Yes |  |
| Spreadtrum | Yes |  |
| Ericsson | Depends on general gap handling discussion | This can be handled in the general gap configuration discussion. |
| Huawei/HiSilicon | Yes | Agree with Vivo. |
| NEC | Yes | Agree with vivo. |
| Nokia | Yes |  |
| ZTE | Yes | Agree with Vivo. |
| Lenovo | Yes |  |
| MediaTek | Yes, but | We also prefer to handle this in general gap configuration section |
| Samsung | See comments | We have no strong view but wonder whether network can change any part of MUSIM gap assistance information and configure it to the UE accordingly or not. |
| Charter Communications | Yes |  |
| Intel | Depends on MGE discussion | Wait for MGE discussion |
| Apple | Yes |  |

**Summary:**

TBD.

1. **Whether to introduce gap ID to identify each configured gap, and support modification or release of gaps via gap ID?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes | Network may modify or release the configured gaps via the gap ID, assuming ToAddModList/ToReleaseList is agreed in Q8 for the gap configuration. |
| OPPO | Yes |  |
| Spreadtrum | Yes |  |
| Ericsson | Depends on general gap handling discussion | See comment on Q8. |
| Huawei/HiSilicon | No | The order of the entity in the requested “*musim-GapRequestList*” provided by the UE in UAI message implicitly indicates the gap ID. Based on this gap ID, NW may modify or release the configured gaps. The same method is used in current spec and there is no need to define explicit gap ID. |
| NEC | Yes | Agree with vivo. |
| Nokia | Yes |  |
| ZTE | Yes(with comments) | So this question is for the RRCReconfiguration message instead of the UAI, right? If it is, we agree . |
| Lenovo | Yes |  |
| MediaTek | Yes, but | We also prefer to handle this in general gap configuration section |
| Samsung | See comments | We think that this depends on answer to Q8. If ToAddModList/ToReleaseList is agreed in Q8,gap ID is needed to identify each configured gap. |
| Charter Communications | Yes |  |
| Intel | Depends on MGE discussion | Wait for MGE discussion |
| Apple | Yes |  |

**Summary:**

TBD.

In RAN2#115e agreement, “*The switching gap configuration will explicitly provide the gap starting position (e.g. offset value or start SFN and subframe explicitly), gap length and gap repetition period.*”.In the rapporteur’s understanding, NW configures gap repetition and offset for periodic gaps, and configures start SFN and subframe for aperiodic gaps.

Companies are invited to express their view on the following question.

1. **Do companies agree that NW configures start SFN and subframe for aperiodic gaps?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes | NW configures gap repetition and offset for periodic gaps, and configures start SFN and subframe for aperiodic gaps. |
| OPPO | Yes |  |
| Spreadtrum | Yes | If the start time of aperiodic gap could be predicted, NW could configures start SFN and subframe. |
| Ericsson | Yes | We think this also affects the modeling on question 4, i.e. if this is agreed then would be better to go with option 2 in question 4. |
| Huawei/HiSilicon | Yes | Similar view as Vivo. |
| NEC | Yes |  |
| Nokia | Yes But | It should be optional. If this is not given NW to start the aperiodic gap immediately on receiving the UAI. |
| ZTE | Yes | Similar view as Vivo. |
| Lenovo | Yes |  |
| MediaTek | Yes |  |
| Samsung | Yes |  |
| Charter Communications | Yes |  |
| Intel |  | Wait for RAN4 discussion on aperiodic gaps. For longer aperiodic gaps, synchronisation of the start between the network and UE may not be that relevant. |
| Apple | Yes |  |

**Summary:**

TBD.

## The LS actions

In the rapporteur’s understanding, some of the above questions are related to the gap patterns which may lead to impact to RAN4. Hence, companies are invited to express their view on the following question.

1. **Whether a LS to RAN4 is needed? If Yes, any content?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes | RAN2 agreements could be sent to RAN4, especially MGL/MGRP value range, which needs RAN4 to further define the applicable gap patterns. |
| OPPO | Yes | Fine to inform RAN4 of RAN2 agreements on MUSIM gap. |
| Spreadtrum | Yes |  |
| Ericsson | No | We should actually wait for RAN4 discussion on the details. |
| Huawei/HiSilicon | Yes | OK to send RAN2 gap related agreements to RAN4 |
| NEC | Yes | OK to send RAN2 gap related agreements to RAN4 |
| Nokia | Yes but | it depends on the conclusions and if it defers from RAN4 understanding as per received LS. Only the agreements which impacts RAN4 work to be included. |
| ZTE |  | We think it depends on the progress of online discussion |
| Lenovo | Yes |  |
| MediaTek | No | It depends on what is agreed in this meeting. So far, we don’t think it is really necessary. |
| Samsung | Yes |  |
| Charter Communications | Yes |  |
| Intel | Yes | We are OK to send an LS to RAN4 on MUSIM gap agreements. Coordination with MGE outcome may be needed. |
| Apple | Yes |  |

**Summary:**

TBD.

## Other Comments

Companies are invited to express their view if any other comments or suggestions on the switching message details.

1. **Any other comments or suggestions on the switching message details?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Gap activation method should be addressed also considering the gap common AI is discussing the joint work among preconfigured MG, concurrent MG, NCSG and MUSIM gap, it’s necessary to define the MUSIM gap activation way to avoid any confusion. Based on above, we propose:  **Upon received by RRC signaling, all the configured MUSIM gap(s) will be activated immediately.** |
|  |  |
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|  |  |
|  |  |

**Summary:**

We may further discuss above questions based on contributions.

# Conclusions

Based on the email discussion, we give the below proposals.

**TBD.**

# References

1. RAN-94e Meeting Report
2. R2-2200132 Reply LS on gap handling for MUSIM (R4-2120342; contact: vivo) RAN4 LS in Rel-17 LTE\_NR\_MUSIM-Core To:RAN2 Cc:RAN
3. R2-2108861 LS on gap handling for MUSIM
4. R2-2200800 Running NR RRC CR for MUSIM vivo draftCR Rel-17 38.331 16.7.0 LTE\_NR\_MUSIM-Core
5. R2-2200803 Remaining open issues on MUSIM Switching vivo other Rel-17 LTE\_NR\_MUSIM-Core
6. R2-2200489 Configuration of MUSIM Gaps Qualcomm Incorporated discussion
7. R2-2200920 Remaining issues for NW switching without leaving RRC\_CONNECTED Huawei, HiSilicon discussion Rel-17
8. R2-2200230 Remaining Details for Periodic and Aperiodic Gaps OPPO discussion Rel-17 LTE\_NR\_MUSIM-Core
9. R2-2201482 Discussion on switchover procedure without leaving RRC\_CONNECTED state Ericsson discussion
10. R2-2201633 Measurement Gaps Open issues Rakuten Mobile, Inc discussion Rel-17
11. R2-2201481 Remaining Issues for MUSIM Network Switching Charter Communications, Inc discussion
12. R2-2200671 On remaining issues for MUSIM Gap configuration Nokia, Nokia Shanghai Bells discussion Rel-17
13. R2-2200950 Discussion on RAN4 Reply LS on MUSIM gaps Samsung R&D Institute India discussion
14. R2-2201483 Discussion on switchover procedure for leaving RRC\_CONNECTED state Ericsson discussion
15. R2-2200231 Remaining Details on MUSIM Assistance Information for Leaving Case OPPO discussion Rel-17 LTE\_NR\_MUSIM-Core
16. R2-2200904 Remaining issues for NW switching with leaving RRC\_CONNECTED Huawei, HiSilicon discussion Rel-17
17. R2-2201234 Consideration on the Switching with Leaving Connected State ZTE Corporation, Sanechips discussion Rel-17 LTE\_NR\_MUSIM-Core
18. R2-2201316 Further details on network switching notification MediaTek Inc. discussion R2-2111222
19. R2-2200211 Remaining issues on network switching for MUSIM Samsung Electronics Co., Ltd discussion Rel-17 LTE\_NR\_MUSIM-Core
20. R2-2200572 Remaining issues on scheduling gap for network switching NEC discussion Rel-17 LTE\_NR\_MUSIM-Core
21. R2-2200359 Remaining open issues on network switching for MUSIM Intel Corporation discussion Rel-17 LTE\_NR\_MUSIM-Core
22. R2-2201215 Release of MUSIM Gap Sharp discussion
23. R2-2200754 Remaining issues for switching notification and busy indication Lenovo, Motorola Mobility discussion Rel-17
24. R2-2200522 Remaining issues of Network switching for MUSIM China Telecom discussion Rel-17 LTE\_NR\_MUSIM-Core
25. R2-2201201 MUSIM Signaling aspects for Scheduling gap handling Apple discussion Rel-17 LTE\_NR\_MUSIM-Core
26. R2-2201369 Remaining issues for MUSIM gap configuration LG Electronics France discussion Rel-17
27. R2-2201233 Further Consideration on the Scheduling Gap ZTE Corporation, Sanechips discussion Rel-17 LTE\_NR\_MUSIM-Core
28. R2-2200631 UE indication on switching Spreadtrum Communications discussion Rel-17

# Annex B: Agreements

In the previous RAN2 meetings, the following agreements were taken:

Agreement (RAN2#113bis-e)

1 RRC signalling is used for switching procedure without leaving RRC\_CONNECTED state in network A for UE temporarily switching to network B as a baseline. FFS on additional need of MAC signalling.

Agreements (RAN2#114e)

1: RRC signalling for network switching without leaving RRC\_Connected state should allow multiple configurations of periodic “gaps” with different parameters (e.g. periodicities and durations). FFS is multiple can be active at the same time. FFS if multiple aperiodic gaps are supported.

4: UE provides assistance information to the gNB of NW A in Connected state based on the configuration of USIM of NW B for the gNB to determine the necessary switching parameters. Up to network what is the action based on UE assistance information. FFS what assistance information is needed.

Agreements (RAN2#115e)

* Only per UE level scheduling gap is supported in Rel-17 for non-DC. FFS if we support MR-DC.
* The network is allowed to configure at most 3 gap patterns (for any MUSIM purpose).
* Only a single aperiodic gap (for MUSIM) is supported in Rel-17. At most two periodic “gaps” (for MUSIM) and a single aperiodic gap (for MUSIM) is supported in Rel-17. FFS if signalling supports more.
* The SFN and subframe of the PCell of the network A is used in the gap configuration to calculate the gap.
* The switching gap configuration will explicitly provide the gap starting position (e.g. offset value or start SFN and subframe explicitly), gap length and gap repetition period.
* Switching Gaps (of any type) are configured or released by RRC signalling (e.g. RRCReconfiguration message) in Rel-17. FFS if gap can be released autonomously by UE after N repetitions.
* UE is allowed to include assistance information for setup or release of gaps for both 1) periodic gaps and 2) aperiodic gap in one UEAssistanceInformation Msg.
* To report the assistance information, the UE maps the timing info of the Gap on the network B to the network A and reports the mapped timing info to the network A.
* For the gap assistance information, the Gap start time, Duration of the gap and gap repetition period (for periodic) may be included. FFS is other information is included (e.g. gap purpose).
* Do not support autonomous gaps for MUSIM in Rel-17.

Agreements (RAN2#116e)

- RAN2 will not specify MN-SN coordination of MUSIM gaps with MR-DC in Rel-17.

- RAN2 will not create MAC CE activation of gaps in MUSIM, but if the common gap discussion allows this anyway, RAN2 will not prevent that, either.

1: RAN2 will not work in Rel-17 for the case that Dual-RX/Single-TX UE or Single-RX/Single-TX UE stays in RRC\_CONNECTED mode in NW A while performing reception and transmission in NW B (in RRC\_ CONNECTED or during RRC setup/resume period).

2: MR-DC is not supported in Rel-17.

- Wait for RAN4 feedback on gap pattern support (can use FFS in RRC for maximum value)

4: RAN2 understands that the intent of aperiodic gap is as follows (no need to specify):

- If until the end of the aperiodic gap the UE still has not completed activity in NW B, e.g. due to the random access for on-demand SI request, the UE should stop the activity in NW B and switch to NW A. If needed, the UE can request another aperiodic gap in NW A.

- RAN2 does not intend to specify any new signalling in Rel-17 for early return. If legacy signalling allows it, RAN2 does not intend to preclude it.

5: Do not introduce gap purpose for gap related MUSIM assistance information.

6: FFS how UE indicates release of gap pattern.

7: FFS if UE is allowed to update UAI message after the UE performs cell reselection in NW B or after the UE performs handover in NW A.

8: Autonomous release of MUSIM gap by UE after N repetitions is not supported.