**3GPP TSG-RAN WG2 Meeting #115e R2-21xxxxx**

Online, 9th –27th August 2021

**Agenda item: 8.3.3**

**Source: vivo**

**Title: [Post114-e][242][MUSIM] Switching message details**

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

**Document for: Discussion and Decision**

# Introduction

This document aims to collect views from companies for the following email discussion agreed during RAN2#114e:

* [Post114-e][242][MUSIM] Switching message details (vivo)

Scope: Discuss message design (information to include, which messages, etc.).

Intended outcome: Discussion report

Deadline: Long

# 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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| Intel | Sudeep.k.palat@intel.com |
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## General

In this email discussion, we will discuss the details of the network switching notification signaling, including the content of assistance information for switching notification, which message is used to deliver the assistance information, etc.

**Please note that gap handling details, e.g. gap configuration assistance information and gap configuration details would be discussed in [Post114-e][243][MUSIM] Gap handling (ZTE).**

According the previous discussion, at least RRC network switching notification for leaving RRC\_Connected state will be specified. In this email, we refer to RRC network switching notification for leaving RRC\_Connected state when network switching notification for leaving RRC\_Connected state is mentioned.

The previous agreements on network switching notification is copied in the Annex for your convenient.

## Network Switching Signaling

### **Assistance information for network switching notification**

According to the previous discussion, UE may provide the assistance information in switching notification message during the below procedures.

* Network switching for leaving RRC\_CONNECTED state(AS-based solution).
* Network switching without leaving RRC\_Connected state.

Here, we will discuss what assistance information is needed. Below assistance information contents in Table 1 are proposed in company contributions.

**Table 1: Assistance information content for switching notification**

|  |  |
| --- | --- |
| **Procedure** | **Assistance information content** |
| Network switching for leaving RRC\_CONNECTED state (AS-based solution) | * *releasePreference,* including preferred RRC state [4, 5, 10] after network switching, such as RRC\_IDLE, RRC\_INACTIVE, outOfConnected. * NAS information[7,10,13]: e.g.   + MT restriction information[7,13], to temporarily restrict/filter MT data/signalling handling.   + Expected leaving time/duration [13], which is used to assist the network to decide the duration to block MT data/signaling for the UE. |
| Network switching without leaving RRC\_Connected state | * *releasePreference,* including preferred RRC state [10] after network switching, such as RRC\_CONNECTED. * Purpose of switching notification[7,22], such as TAU, RNAU, busy indication, etc.   **The assistant information for gap configuration would be discussed in [Post114-e][243][MUSIM] Gap handling (ZTE)** |

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

1. **Which of the following assistance information need to be carried in the switching notification message?**

Option 1: *releasePreference,* including preferred RRC state, such as RRC\_IDLE, RRC\_INACTIVE, RRC\_CONNECTED，outOfConnected*.*

Option 2: NAS Container*,* including NAS information, such as MT restriction information*,* NAS information*,* expected leaving time/duration, etc*.* Details can be decided by other WGs.

Option 3: Purpose of switching notification, such as TAU, RNAU, busy indication in another network, etc.

Option4：Assistant information for gap configuration, details are discussed in [Post114-e][243][MUSIM] Gap handling (ZTE)

Option 5: Please comment.

|  |  |  |
| --- | --- | --- |
| **Company** | **Options (1, 2, 3, 4)** | **Comments** |
| OPPO | Option 1 and Option 4 | Option 1 is for leaving case while Option 4 is for without leaving case.  Regarding to Option 2, the requirement should come from SA2, RAN2 alone cannot make the decision.  As for Option 3, Option 4 is enough to reflect the requirement, no need to introduce another similar solution. |
| ASUSTeK | 1, 2, 3, 4 | Options 1, 2, and 3 could be used for the case to leave RRC\_CONNECTED.  Options 1, 3, and 4 could be used for the case without leaving RRC\_CONNECTED. |
| NEC | 1, 4 | For Option 2, it is up to SA2 decision, so we are open to it. |
| MediaTek | option 1 (simplified)  and option 4 (depends on #243) | For option 1, we think the UE could simply indicate whether it want to leave RRC Connected state. We have two kind of switching procedure (leaving or keep in RRC Connected), so it make sense have two kind of preference in the assistance information. We wonder how UE decide to stay in INACTIVE or IDLE for this switching. As in physical layer, INACTIVE and IDLE basically consume same resource. It does not impact the resource sharing to other SIM no matter the UE stay in IDLE or INACTIVE.  Option 2 should be decided by SA2.  Option 3 is not needed as we have option 4.  Option 4 depends on the result of e-mail discussion #243. |
| Lenovo | 1, 3, 4 | The option 2 can be up to SA2.  For option 4, the beginning time point and the length of gap should be provided to the network B. |
| LGE | 1, 4, 5 | For 5, to support NAS procedure e.g., sending MT restriction before RRC release, we think RAN2 can also design a new signal flow to send both AS and NAS information instead of the introduction of NAS container in the UAI message.  Since, to send NAS information via NAS container in AS signaling, the UE AS should indicate to the UE NAS first to include MT restriction and the UE can send the UAI message to gNB, additional delay for MT restriction is unavoidable.  To resolve this additional delay which may cause service interruption, the UE may send the UAI message to release RRC connection and may also send MT restriction information via NAS signaling at once if UAI indicates that MT restriction information will be provided by UE NAS soon.  Thus, we also want to consider this kind of signaling design together to reduce SA2 impact on AS based leaving procedure. |
| Sharp | Option 1, 4  Option 2 is FFS | The need of NAS information should be decided in SA2.  For option 3, the action in another network should be unknown to NW A. |
| vivo | 1, 4 | Option 1 “preferred RRC state” could be used for leaving RRC\_CONNECTED state. *releasePreference* can be reused for Multi-SIM purpose, however, value *”RRC\_CONNECTED”* should not be used for leaving RRC\_CONNECTED state.  Option 4 “Assistant information for gap configuration” could be used for Network switching without leaving RRC\_Connected state. Both Option3 and option 4 are under discussion in [Post114-e][243][MUSIM] Gap handling (ZTE).  Option 2 “NAS Container” is not preferred. |
| Qualcomm | 1, 4 | 1 for leaving Connected state and 4 for staying in Connected state. Option 3 is not needed as it is not useful information for the NW. Option 4 can be decided after SA2 progress; however, a reasonable approach would be to use NAS based switching if a NAS message needs to be transmitted and RRC based otherwise. |
| Apple | 1,2,3,4 | Option 2 to be decided by SA2 as primarily it is NAS information.  Option 1 and 3 needed especially in cases when UE moves of RRC CONENCTED state on NW A.  Option 4 can include NW B IDLE/INACTIVE DRX periodicity to schedule the periodic gap on NW A. |
| CATT | 1,4 | For option 1, agreed with MTK, details of option 1 should be further discussed, it seems it is enough to simply indicate whether UE needs to leave RRC Connected state.  For option 2,it is up to SA2,but we do not think there should be any dependency between NAS based solution and AS based solution.  For option 3,it is not necessary as option 4(gap configuration) is sufficient for gNB to make decision. |
| Futurewei | 1, 4 | Option 2 is not in the scope of RAN2 to decide.  Could consider Option 3 if justified, but no strong opinion. |
| Huawei/HiSilicon | Option 1 and 4 | Option 1 and 4 are enough to cover the switching scenarios. There is no need to include the purpose of switching notification (Option 3).  For Option 1, we don’t see the motivation to indicate the preferred state as “RRC\_CONNECTED” in the MUSIM case.  As others commented, Option 2 is not for RAN2 to discuss. |
| Ericsson | 1, 2, 4 | For opt.1, we could have at least RRC\_IDLE and RRC\_INACTIVE as preferred sate. For RRC\_CONNECTED as preferred state, would it indicate that the UE no longer has a preference for leaving? |
| China Telecom | 1,2,4 | Both Option 1 and 2 in the switching notification message can take the benefit of AS and NAS solution.  Option 4 for leaving case. |
| Intel | 1, 4 | Either 1 or 3 is useful for the network to decide whether to keep the UE in CONNECTED/INACTIVE/IDLE. Since listing every NAS procedure could bring dependency on CT1, 1 is better. |
| Charter Communications | 1, 4 | Details of 2 to be decided by SA2. |
| Samsung | 1, 4 | Option 1 for leaving RRC\_CONNECTED state (AS based solution), and option 4 without leaving RRC\_CONNECTED state.  In general, we prefer not to pursue any optimization issues. Regarding Option 2, we understand that the purpose/usage of AS based and NAS based solutions is different. Hence, support of NAS piggybacking for AS based solution is a minor optimization. Similarly, Option 3 is not essential as it does not help much how UE and NW behave subsequently. Besides, it may lead to security issues since UE behavior in other network will be informed to current one. |
| ZTE | 1 /4, option 2 is FFS | For the option 2, SA/CT1 has agreed (and finished the related CR) with the NAS procedure for the leaving connected case, thus the option 2 would depend on the interaction between UE AS-NAS. For example, if RRC\_based procedure is only used for the case that no NAS level assistance information (e.g MT restriction information) need to be transferred to the CN when leaving, then the option 2 is not needed., otherwise, option 2 shall also be included. |
| Xiaomi | 1 and 4 | Option 2 should be discussed and decided in SA2. |
| DENSO | 1,3,4 | For Option 1, RRC\_IDLE and RRC\_INACTIVE can be used as preferred state for leaving RRC\_CONNTECTED. It is possible to use RRC\_CONNECTED to indicate the switching type is "without leaving RRC\_CONNTED", however, in the case, this field can be blank at all.  Option 2 should be up to SA2.  Option 3 can help network A to decide which state to move UE for the case to leave RRC\_CONNECTED.  Option 4 is necessary for the case without leaving RRC\_CONNECTED. The details are depending on another email discussion. |

**Summary:** TBD

### **message for network switching notification**

Regarding the message for sending network switching notification by the UE, *UEAssistanceInformation* has been proposed by some companies for both switching with leaving RRC\_CONNECTED (AS-based solution) and without leaving RRC\_CONNECTED, shown in Table 2:

**Table 2: Signalling message for switching notification**

|  |  |
| --- | --- |
| **Procedure** | **Signaling message for switching notification** |
| Network switching for leaving RRC\_CONNECTED state (AS-based solution) | * *UEAssistanceInformation* [4,5,10,]. Reuse *UEAssistanceInformation* as switching notification. |
| Network switching without leaving RRC\_Connected state | * *UEAssistanceInformation* [14]. the *UEAssistanceInformation* message is used for switching procedure without leaving RRC\_CONNECTED state. |

Some of the identified potential assistance information, e.g. the preferred RRC state, is already specified UEAssistanceInformation in R16 NR UE Power Save. In the rapporteur’s understanding, for avoiding introduce duplication function in specification, it is natural to extend UEAssistanceInformation message for network switching procedures, with different assistance information included for switching with/without leaving RRC\_CONNECTED.

1. **Whether *UEAssistanceInformation* message can be extended and used for switching notification in both network switching procedures for leaving RRC\_CONNECTED state and without leaving RRC\_ CONNECTED state? If No, please specify**.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes | This is a nature and simple way. |
| ASUSTeK | Yes | The same message could be used for both cases. |
| NEC | Yes |  |
| MediaTek | Yes, but | We are okay extend the *UEAssistanceInformation* to trigger the switching procedure. However, we would like to clarify that “assistance” information used in MUSIM is different from the one used in power saving purpose. For power saving, it would anyway up to network to do the corresponding configuration or not. For MUSIM, it is more like the UE has to leave even if the NW does not response to that.  Note that we think legacy notification (for power saving) could not be used without any extension. The network has to know the purpose of UE want to leave RRC Connected state since the response will be different. |
| Lenovo | Yes | Both switching with leaving RRC\_CONNECTED (AS-based solution) and without leaving RRC\_CONNECTED should use a single message. |
| LGE | Yes |  |
| Sharp | Yes | Unified solution is preferred. |
| vivo | Yes | *UEAssistanceInformation*message can be extended for both Multi-SIM network switching procedures. |
| Qualcomm | Yes | It is fine to assume UAI as a baseline. If we find serious problems in stage-3 details, we can consider a new message/procedure. |
| Apple | Yes | We should use the *UEAssistanceInformation* as a baseline. If anything additionally is needed for MUSIM specific signalling, we can extend the *UEAssistanceInformation* message accordingly as per need. The same *UEAssistanceInformation* needs to be used for both leaving/not leaving RRC CONNECTED state. |
| CATT | Yes |  |
| Futurewei | Yes | We are ok to use the *UEAssistanceInformation* for both cases if feasible. |
| Huawei/HiSilicon | Yes |  |
| Ericsson | Yes |  |
| China Telecom | Yes | Agree with MediaTek. UEAssistanceInformation for multi-SIM purpose should be distinguished with other usages like power saving |
| Intel | Yes but | We are also OK to use *UEAssistanceInformation* if that is the majority view. However, we also agree with MediaTek that this usecase is quite different and we also need to be careful not that this addition does not make the other indications in *UEAssistanceInformation* more complex such as whether delta signalling is used for the indications in *UEAssistanceInformation*. |
| Charter Communications | Yes |  |
| Samsung | Yes |  |
| ZTE | Yes |  |
| Xiaomi | Yes | Using UAI should be the baseline. |
| DENSO | Yes | Agree with OPPO and ASUSTeK. |

**Summary:** TBD

### **Supporting of switching notification function**

In RAN2#114e, it was agreed that “*AS -based solution for network switching includes two steps: 1-) If configured, UE can send an RRC message to leave RRC\_CONNECTED for MUSIM purpose 2-) gNB may release the UE to Idle/Inactive.*”, which means, NW needs to inform the UE whether a network switching notification message for MUSIM purpose is supported or not before UE sending the network switching notification message.

According to the rapporteur’s understanding, one cell may support both or one of the two RRC network switching notifications. Hence, two separate indications should introduce to inform UE which network switching notifications are supported.

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

1. **Whether switching notification for leaving RRC\_CONNECTED state and without leaving RRC\_CONNECTED state should be enabled separately?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes but with comments | For leaving case, the legacy signaling can be reused, i.e. reuse *releasePreference* introduced in R16 PS, so the legacy indication can be reused also for leaving case, no more enhancement is needed.  As for without leaving case, we’re open to discuss whether to reuse a existing indicator or introduce a new indicator to enable the capability. |
| ASUSTeK | No | Unless the need of such flexibility is identified, support/enable of the two cases could be bundled. |
| NEC | No | UE sends assistance information to the network, but whether to leave RRC Connected state or use scheduling gap is up to network decision, it seems no strong need for the case that the network only support one of the two RRC network switching notifications. |
| MediaTek | See Comment | It is not so clear on the question. There are several aspects on the granularity of switching control.  UE capability – It could be further discussed whether UE capability separation is needed. We are okay for UE to support both kind of network notification (leaving connected or not) together but trigger which kind of notification should be up to UE.  NW configuration – We would like to understand (from NW vendors) that whether this kind of flexibility is needed.  UE switching notification – It should be up to UE implementation (depends on the purpose of other SIM) to indicate whether it want to leave RRC Connect or not. If the UE want to leave RRC Connected state to perform some network B activities but the Network A does not enabled this, the UE has to fallback to legacy behavior (i.e. leave network A without notification). |
| Lenovo | No | We don’t see the use case to have the separate ‘enabled’. |
| LGE | Yes with comments | It seems up to the network capability. Also the legacy signalling can be reused. |
| Sharp | No | We do not see the necessary to have separated indications. |
| vivo | Yes but with comments | Separate enabling is up to network requirement. There could be AS or NAS solution for leaving connected procedure. Network may only enable AS solution for keeping connected procedure, but support NAS solution for leaving connected procedure.  If needed, it’s easy to separately enable the two switching notification procedures. Considering different configurations are required for each switching notification message sending, we may use the presence of corresponding configuration to indicate the enabling of different switching procedures. E.g.   * prohibit timer for switching notification message sending in case of without leaving RRC\_CONNECTED state. If present, switching notification without leaving RRC\_CONNECTED state is enabled   “configured time”, for the UE to leave RRC\_CONNECTED without a response is configured by the gNB. If present, switching notification for leaving RRC\_CONNECTED state is enabled. |
| Qualcomm | Yes | All of the different types of UE reporting in UAI are configured by the NW separately. The gap configuration and leaving Connected state are different features and thus they should not be configured together. For the leaving case, we can discuss whether it is sufficient to re-use or extend the existing R16 r*eleasePreference* indication. |
| Apple | See Comment | This should be a function of both UE and NW capability. If it helps to clarify by having two separate capabilities, we are fine with it. Agree with MTK, that in case NW does not support no leaving RRC CONNECTED state, UE has to fallback to legacy behavior. |
| CATT | No | We do not see the need to separate network capability as this. |
| Futurewei | Yes | The network may not support the AS solution for leaving RRC\_CONNECTED state. Therefore, it seems cleaner to support separate indications. |
| Huawei/HiSilicon | No | Just “one indication” to indicate enabling of the switching procedures for without leaving and leaving RRC\_CONNECTED is enough. |
| Ericsson | Yes | The NW should be able to configure the UE for switching notification for leaving RRC\_CONNECTED, without leaving RRC\_CONNECTED or both |
| China Telecom | No | We can not see the scenario of only enabling one kind of switching. |
| Intel | No | If we understand the question correctly, this is about whether UE is allowed to signal these separately. We don’t see a need for this as we think one indication from UE is sufficient. Assistance information could possibly also include preferred UE state. |
| Charter Communications | Yes | A separate treatment of the two cases allows the NW to deal more efficiently. |
| Samsung | Yes with comments | It may depend on how to define UE radio access capability information. Considering that both RRC and NAS based switching for leaving are supported, UE may choose not to implement RRC based switching for leaving while implemeting NAS based switching for leaving. If so, we will end up with introducing two separate capability bits i.e. one to indicate whether RRC based switching notification for leaving is supported and another to indicate whether switching notification without leaving is supported. Similarly, there seems no harm to have such flexibility from NW side. |
| ZTE | Yes but with comments | We understand the intention of this question is to ask whether the network can request UE to report the assistance information for leaving connected state and without leaving connected state separately.  About whether can reuse the legacy signaling, we think more discussion is needed. From network side, it would be helpful to know the leaving reason (e.g. MUSIM or power saving) for the KPI statistics, thus maybe a new releasePreference-R17 can be introduced for MUSIM and including only IDLE/Inactive. For the switching case without leaving connected state, it can be implicitly indicated by gap assistance information.  Furthermore, the other config is also based on the UE capability, it’s better to separate the MUSIM feature and Power Saving feature to avoid unnecessary complexity. Maybe RAN2 also need to discuss whether separate UE capability indication are needed for the switching with/without leaving connected state respectively. |
| Xiaomi | No | There is no strong need to separate these two. |
| DENSO | Yes | We guess there is case that NW can enable only one switching type depending on the capability or configuration of gNB/core network. |

**Summary:** TBD

1. **How to inform UE that RRC based switching notification function is supported by NW?**

Option 1: Extend the existing configuration mechanism of UE assistance information, to inform UE that RRC based switching notification message is supported by NW in *otherConfig* of *RRCReconfiguration* message*.*

Option 2: please specify if any new methods

Option 3: None, the UE does not need to know if the network supports RRC based switching.

|  |  |  |
| --- | --- | --- |
| **Company** | **Option (1, 2)** | **Comments** |
| OPPO | Prefer Option 1 | But we think we should reuse the existing indicator as much as possible, just like the comments in Q3. |
| ASUSTeK | 1 | Current mechanism could be reused. |
| NEC | Option 1 | Reusing existing mechanism is sufficient. |
| MediaTek | FFS | We are fine to put this network configuration in *otherConfig* of *RRCReconfiguration*. We however want to clarify that only MN should enable this feature. Note that for power saving, the assistance information could be enabled by MN or SN independently.  Another alternative is to just put this configuration in first level of RRC Reconfiguration (e.g. in *RRCReconfiguration-v1710-IEs*). It seems no urgent to conclude this detail ASN.1 at this moment. |
| Lenovo | Option 1 | Reusing the existing otherconfig IE. |
| LGE | 1 |  |
| Sharp | Option 1 |  |
| vivo | 1 | Same as Q3.  Extend the existing configuration mechanism. *otherConfig* of *RRCReconfiguration* message can include multi-SIM configuration. If the multi-SIM configuration is present, RRC based switching notification function is supported. |
| Qualcomm | Option 1 | Don’t see any problems with Option 1 at the moment; can be further discussed in running CR if needed. |
| Apple | Prefer option 1 |  |
| CATT | 1 |  |
| Futurewei | No strong opinion | Seems like a stage 3 detail. Not sure we need to conclude anything at this point. |
| Huawei/HiSilicon | Option 1 | It is straightforward to reuse the *otherconfig.* |
| Ericsson | 3 | The UE just needs to know if it is configured to provide UE assistance info for RRC based switching, which can be provided by the network, as discussed in the previous questions. Hence, if the UE is not configured to provide such UE assistance info, it will not matter whether the network supports or not the feature, the UE will not be able to report it anyway; if the UE is configured to provide such UE assistance info, then the network supports the feature. |
| China Telecom | 1 | Option 1 is simpler. |
| Intel | Option 1 |  |
| Charter Communications | 1 |  |
| Samsung | 1 |  |
| ZTE | Option 1 with comments | As commented above, the other config is used to indicate what does the network want to request, instead of what does the network supported. |
| Xiaomi | 1 |  |
| DENSO | Option 1 | This is simple way and no issue found so far. |

**Summary:** TBD

### **Configuration for autonomous switching**

The agreement has been achieved that “*During switching procedure for leaving RRC\_CONNECTED state, UE is allowed to enter RRC\_IDLE state if it does not receive response message from network within a certain configured time period. FFS for RRC\_INACTIVE state.*”

Regarding to whether UE is allowed to enter RRC\_INACTIVE state if not receive NW response message within a certain configured time period, views are summarized based on company contributions:

* **Allowed:**[2, 5, 11, 18]
  + The UE is allowed to enter Inactive state assuming this was the UE preference[2].
  + UE is allowed to configure the RRC state to transit in advance of triggering the switching procedure with leaving RRC\_CONNECTD for some specific scenarios(FFS: what scenarios to make configurable), to avoid mismatch of the RRC state transition between the UE and network A [8].
  + The RRC state to which the UE should be transferred to can be preconfigured via RRC signalling procedure. The pre-configuration can also include the state transition information depending on the time of return. This preconfigured return behavior enables the UE to leave NTWK-A without waiting for the network response.[11]
* **Not Allowed:**[4, 8, 14, 21, 24]
  + It's not feasible as RRC\_INACITVE state is associated to a RAN-based notification area which is configured by network [8]
  + The RRC state mismatch issue may happen between network A and UE if UE autonomously leaves network A. [4]
  + It is not practical to pre-configure the *suspendConfig* to the UE. It consumes RNTI resources as if *fullI-RNTI* and *shortI-RNTI* is pre-configured to a UE, it cannot be used by other UEs which are actually in the RRC\_INACTIVE state. Moreover, as it is unpredictable whether/when a UE will request to leave RRC\_CONNECTED state, the pre-configured *suspendConfig* may never be used which just wastes RNTI resources.[21]
  + The network should maintain the suspend configuration for the UE until performing the long-term SIM switching. The problem is that the network doesn’t know when the UE would perform the long-term SIM switching. Thus, supporting timer-based leaving in RRC INACTIVE will decrease the network performance from the resource handling point of view because the network may not handle promptly to the other UEs which require RRC\_INACTIVE.[24]
  + There is no real to support autonomous transition from RRC\_CONNECTED state to RRC\_INACTIVE state. The concerned scenario is rare so it merely entails specification complexity with marginal benefit.[14]

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

1. **Is UE allowed to enter RRC\_INACTIVE state if no NW response message is received within a certain configured time period after the network switching notification message is sent?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | No | As analyzed above, the drawback is quite obvious but the benefit is not significant. More addition, to simplify our work, ‘Not allowed’ has less spec impact, so we prefer to say ‘No’. |
| ASUSTeK | No | Entering RRC\_INACTIVE autonomously may be considered in general (not only for this case) in later release. |
| NEC | No | Entering RRC\_IDLE autonomously is sufficient. Entering RRC\_INACTIVE requires big specification impact, however brings small benefit. |
| MediaTek | No | In INACTIVE mode, UE and NW should have common understanding on the UE Inactive context. So, autonomously transit to INACTIVE mode does not work, it will create lots of problem. |
| Lenovo | No | Entering RRC\_Inactive autonomously will result in mismatching between UE and network. In addition, UE has no I-RNTI for inactive state. |
| LGE | No | The problem is that the network doesn’t know when the UE would perform the long-term SIM switching. Thus, supporting timer-based leaving in RRC INACTIVE will decrease the network performance from the resource handling point of view. |
| Sharp | No | The drawbacks is quite obvious and the benefit can be achieve by providing a response to UE before the timer timeout. |
| vivo | No | UE should be not allowed to enter RRC\_INACTIVE state if no NW response message is received within a certain configured time period after the network switching notification message is sent.  As views of company contributions show, if allowed, pre-configuration of *suspendConfig* is needed, it leads to increased complexity and resource wastage, but benefit is marginal. |
| Qualcomm | Yes | The only real drawback of this will be pre-configuring the UE with suspendConfig. However, this can be up to the NW. If the NW does this configuration and the UE prefers to be released to Inactive, this should be allowed. Without any suspendConfig, the UE should obviously move to Idle. |
| Apple | See Comment | Though this autonomous transition to INACTIVE would prevent the UE from staying indefinitely waiting for a response from NW, we do agree that this would work only with a predefined *suspendConfig* to UE. |
| CATT | No | Agree with above companies that there are little benefits but need a complex solution. |
| Futurewei | No | UE needs to receive I-RNTI from network before entering RRC\_INACTIVE. |
| Huawei/HiSilicon | No | Due to the issues described in our contribution [21], autonomous switching to RRC\_INACTIVE shall not be allowed. |
| Ericsson | No | There might be a misconfiguration if the UE moves to RRC\_INACTIVE without receiving the RRCRelease message (e.g. I-RNTI, RAN Paging cycle, RNA Info, etc. are not received) |
| China Telecom | No | Hard to align between NW and UE. It is safer to enter IDLE state for both sides if no NW response message is received within a certain configured time period |
| Intel | No | Entering RRC INACTIVE autonomously creates problems as UE does not have the configuration for it that is normally provided in RRC Release. |
| Charter Communications | See comment | As described by others, the suspendConfig must be configured in advance. It is not clear based on what information NW A can judiciously configure suspendConfig in advance. |
| Samsung | No |  |
| ZTE | No | Same view as OPPO. For the scheme with pre-configured *suspendConfig* , besides the problems mentioned above, we also have concern on the NCC pre-configuration. |
| Xiaomi | NO | We don’t see much need for this and this will need lots of standardization work if introducing it. |
| DENSO | Yes | Agree with Qualcomm and Apple. It is effective to improve user experience and is possible if suspendConfig is somehow provided to UE in advance. |

**Summary:** TBD

During switching procedure for leaving RRC\_CONNECTED state, UE is allowed to enter RRC\_IDLE state if it does not receive response message from network within a certain configured time period. The agreement has been achieved that “*The ‘configured time’ for AS-based solution for the UE to leave RRC\_CONNECTED without a response is configured by the gNB.*”

Regarding how to provide the “configured time” by the NW, [14] points out that it seems sufficient to re-use existing *dataInactivityTimer* i.e. UE enters RRC\_IDLE state autonomously upon the expiry of *dataInactivityTimer* during switching procedure for leaving RRC\_CONNECTED state, and suggests RAN2 to discuss whether to introduce new timer for autonomous UE state transition during switching procedure for leaving RRC\_CONNECTED state.

In rapporteur’s understanding, as discussed in Question 3, another possible method is to provide the “configured time” in the RRCReconfiguration message which enables network switching notification message sending.

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

1. **How to provide the “configured time” by the NW which is used for the UE to leave RRC\_CONNECTED without a response?**

Option 1: Introduce a new timer for the “configured time”, provided in the RRCReconfiguration message which enables network switching notification message sending.

Option 2: Reuse the existing timer for the “configured time”. Please specify which existing timer can be reused, e.g. *dataInactivityTimer*.

Option 3: Please comment.

|  |  |  |
| --- | --- | --- |
| **Company** | **Option (1/2/3)** | **Comments** |
| OPPO | Option2 | We slightly prefer to reuse the legacy timer. |
| ASUSTeK | 1 | It is more straightforward to introduce a new timer. |
| NEC | Option 1 | New timer is better. Mixing with existing timers requires additional efforts, for example dataInactivityTimer is a MAC layer timer, while here we are expecting a RRC layer time. |
| MediaTek | Option 1 | New timer is preferred. The purpose of *dataInactivityTimer* and this MUSIM guard timer is different. It is easier to keep two independent timer. |
| Lenovo | Option 2 | *dataInactivityTimer* can be reused. |
| LGE | 1 | It is more straightforward |
| Sharp | Option 1 | New timer is preferred. |
| vivo | 1 | Introduce a new timer for the “configured time”, the timer value is provided in the RRCReconfiguration message.  Regarding *dataInactivityTimer* is not suitable for this MUSIM purpose, because of the granularity (>=1s) and controlling by MAC. |
| Qualcomm | Option 1 | The dataInactivityTimer was introduced for a very different problem and is usually set to a large value. Also agree with NEC that the new timer should be handled by RRC as opposed to data inactivity in MAC. |
| Apple | Option 1 | New MUSIM specific timer is better. This shold be handled in RRC unlike data inactivity timer which is implemented in MAC. |
| CATT | 1 | It is necessary to support separate timer values for different functions. |
| Futurewei | Option 1 | It seems cleaner to introduce a new timer |
| Huawei/HiSilicon | Option 1 | Share the same view as NEC and MediaTek. |
| Ericsson | 2 | The dataInactivityTimer could be reused, there is no need to add complexity by introducing another timer. |
| China Telecom | 1 |  |
| Intel | Option 1 | *dataInactivityTimer* in our understanding is for quite different purpose (for inactivity). |
| Charter Communications | Option 1 | Agree with others that the applicability and effectivness of the *dataInactivityTimer* is questionable. |
| Samsung | No strong view | Option 2 may work in most cases as no response from NW may be an exceptional case. On the other hand,we also acknowledge that it seems cleaner to introduce a new timer and it may allow UE to quickly leave RRC\_CONNECTED state autonomously. But in general RRC timers start on the initiation of the procedure rather than successful transmission of RRC message. Hence, we just wonder whether we need to consider a potential mismatch in RRC states at UE and gNB with a new (potentially shorter) timer. |
| ZTE | 2 | Share the same view as Ericsson. |
| Xiaomi | Option 1 | It’s better to introduce a new timer for this specific case. |
| DENSO | Option 1 | Agree with Qualcomm. It should be separated timer. |

**Summary:** TBD

[8] thought, switching without the response from network for a certain time is also valid for switching procedure without leaving RRC\_CONNECTED state. i.e. during switching procedure without leaving RRC\_CONNECTED state, UE is allowed to perform switching without the response from network for a certain time.

1. **Is UE allowed to perform switching without the response from network for a configured time during switching procedure without leaving RRC\_CONNECTED state?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Maybe No | If the task in network B can be done within the existing gap duration configured in network A, UE does not have to wait a configured timer. In this case, UE network switching is invisible to network A, no spec work is identified.  As for second case, i.e. a new gap configuration is needed for UE from network A to complete the task in network B, in this case, we think UE should wait the response from network A to at least get the new gap configuration, otherwise, the resource scheduling misalignment will happen between UE and network A. In short, UE should wait the response from network A for the second case. |
| ASUSTeK | No | Agree with OPPO. |
| NEC | Maybe No | Agree with OPPO |
| MediaTek | No | It seems complicate and not so useful to specify this kind of behavior in SPEC. If the UE request some kind of gap for MUSIM purpose and the NW does not configure suitable one, the UE will fall back to “legacy” behavior. The UE will try to continue the connection in network A and may use autonomous gap if the network B activity indeed has higher priority. We can leave this to UE implementation. |
| Lenovo | No | Agree with Oppo. |
| LGE | No | A gap would be better to be used then since RAN2 has already agreed with the general principles of leaving procedure w/o RRC Connection release as the gap handling. |
| Sharp | No | Agree with OPPO and LG. |
| vivo | Yes | UE should be allowed to switch to NW B for short-time activities (i.e. for paging monitoring ) without leaving RRC\_CONNECTED state in NW A even no response to switching notification is received from NW A. Otherwise, UE may miss incoming voice call in NW B.  For other cases, such as performing TAU in NW B, UE can stay in NW A and send switching notification request later if no response from NW A is received.  Hence, we prefer to allow UE switch to NW B for short-time activities (i.e. for paging monitoring) without leaving RRC\_CONNECTED state in NW A even no response to switching notification is received from NW A and UE can decide whether to switch by implementation. |
| Qualcomm |  | For periodic switching, just like measurement gaps, there should be an explicit NW configuration. For aperiodic gaps, there may be cases where the UE should switch in a certain time and it might help to allow the UE to switch without NW response. This is assuming that the configuration for the aperiodic gap is done in advance and thus the NW will be aware of the UE action when the UE sends the request for the aperiodic switch. |
| Apple | No | It is clean to wait for the acknowledgement from NW to do the periodic/aperiodic switching configuration without leaving RRC\_CONNECTED state as it ensures proper UE NW state sync. If for periodic switching (short switching) which happens every so often, if the signaling to inform the NW of switching out an switching in from NW A is perceived higher, then we can exclude that case. For Aperiodic switching it is better to inform and get a NW A ack prior to switch, as it is not a very frequent event (like periodic switching) |
| CATT | Yes | Agree with Vivo,  UE is aware of whether the activity on a specific network (network A or network B) is more important. Hence UE should be allowed to autonomously perform the switching if UE determine that activity in network B is more important. This can be a general principle valid for all kinds of switching procedures(i.e. with or without leaving RRC\_CONNECTED state). |
| Futurewei | No, but | Generally, we agree with OPPO. However, for the first case “If the task in network B can be done within the existing gap duration configured in network A”, we think the UE need not initiate the switching procedure with network A at all. |
| Huawei/HiSilicon | See comments | We understand there are two points in this question.  Point 1: Whether the UE is allowed to perform switching without the response from network during switching procedure without leaving RRC\_CONNECTED state?   * For this, our answer is yes. If no response from NW A is received, it is up to UE implementation on how to perform the activity in NW B as the UE anyway needs to perform for example paging monitoring in NW B.   Point 2: Whether a time period that UE needs to wait for the NW response should be specified as for the case of leaving RRC\_CONNECTED state?  For this point, our answer is No. How long time the UE will wait for the response should be up to UE implementation. |
| Ericsson | No | The question is only relevant for the aperiodic gaps. For the periodic gaps the UE does not need to notify the leaving, since the gaps are already configured. If the UE can use the periodic gaps to perform aperiodic actions, then it is not needed for the UE to notify the leaving. |
| China Telecom | No | Agree with MTK, UE can fall back to “legacy” behavior |
| Intel | Yes | If network did not provide a response in the configured time, it can be left to UE implementation whether UE stays connected or not. Network may release the UE in the meantime but normal protocol handling can take care of any state mismatch. |
| Charter Communications | No | As identified above by others, for periodic gaps there is no need to notify the NW. For aperiodic short-leave, there may be a state mismatch bewteen the UE and NW, unless via the start of the aperiodic gap is known to NW. |
| Samsung | No |  |
| ZTE | No | We think in the last meeting, it has been agreed that “ Up to network what is the action based on UE assistance information.”, it’s better to respect the decision of the Network, the UE shall not switch without network’s allowance. If the UE still want to switch, it can switch with leaving connected state. |
| Xiaomi | Maybe Yes | Only if the autonomous gap is introduced and the waiting time for the response from the network is up to UE implementation. |
| DENSO | No | Agree with OPPO. UE should wait for the response from network to avoid the resource scheduling misalignment. |

**Summary:** TBD

### **Early Return during switching procedure without leaving RRC\_CONNECTED state**

Some companies discussed whether early return is allowed during switching procedure without leaving RRC\_CONNECTED state.

[11] proposed RAN2 to provide signalling mechanisms to allow the UE’s early return and NW-A possibility to schedule traffic in the remaining (non-used) part of the gap. For example, the UE has to monitor for paging in all PO locations in NW-B for which it has required a periodic gap from NW-A. However, in majority of occasions the UE may not find any paging addressed to it and may identify it quite early if an early paging indication is applied. The remaining time can be used by NW-A to reduce the impact due to interruption in data traffic.

[2] thought RAN2 can consider enhancements to optimize the switching operation such as early termination or extension of the gap via MAC signaling. The potential enhancement is for the UE to inform the NW when it returns from the switch. This can be especially useful for relatively longer duration aperiodic switching if the UE is able to return faster.

[7] thought that a return message from the UE to the network is not needed for one-shot short-time switching in case of the early return.

1. **Whether early return is allowed during switching procedure without leaving RRC\_CONNECTED state? If Yes, what’s the signalling for early return?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | No | Usually, the gap duration is not too long, i.e. several milliseconds and the service QoS in network A can still be maintained, the benefit for early return is not significant considering limited remaining gap duration, more addition,  early return will also make the network A resource scheduling more complex, so the benefit is not clear.  If companies want to introduce larger gap duration, this may impact other group, e.g. RAN4/CT1, RAN2 alone can not assume any enhancement at this stage. More details can be discussed in email#243. |
| ASUSTeK | Yes | The same RRC message used to request the gap can be used to modify or cancel the gap. |
| NEC | No | Considering the length of the gap, there is limited benefit for the early return. And as there is no UL grant scheduled during the gap, the early return indication can only be relied on some pre-configured UL resources, for example SR and RA resource, which requires some specification efforts. Therefore, we don’t support the idea of early return indication. |
| MediaTek | Maybe not | For one-shot gap, it is not necessary as the duration is usually short, also the UL grant issue (mentioned by NEC) should be considered.  For periodical gap, it maybe ok for UE to indicate this gap is not needed anymore. This depends on the result of e-mail discussion #243, so we could keep it FFS for now. |
| Lenovo | Yes | The same RRC message as the request message e.g UEAssistanceInformation message can be reused to notified. |
| LGE | No | Agree with OPPO |
| Sharp | Yes | Agree with the reasons provided by the proponent. |
| vivo | Yes | It is difficult for UE to decide the exact length for one-shot short-time switching in many cases. To ensure the gap is enough for the execution of NW B activities, normally the assigned gap is longer than required, UE can early return to network A before the gap expires, in such case early return to notify network A may be useful for data transfer ASAP. Otherwise, the wastage of the remained gap will do harm to data through-put.  The signaling for early return can be SR or RA. |
| Qualcomm | Yes | Due to the uncertainty on the other NW, the UE will likely have to request the gap duration for the worst case. It will be very useful not to waste the remaining time for the sunny case scenarios when the action on the other NW finishes earlier. |
| Apple | No | The benefit of this early return is not fully studied, and in most cases it is not clear on how many instances this opportunity for this early return will exist in the first place. Also the additional time spent in informing the NWA of early return might compensate against the total time saved as part of early return. |
| CATT | Maybe not | Agree with MTK that UE can request to release the periodical gap if it is not needed anymore. |
| Futurewei | Maybe not | There does not seem to be a strong enough use case to support this optimization. However, we are open to discuss it if shown to be warranted. |
| Huawei/HiSilicon | No (See our comments) | For the switching procedure without leaving RRC connected state, we think it should only be applicable to the cases where the UE can predict the leaving time in NW A. In such cases, it will not happen that the UE needs to return early to NW A.  For the special case mentioned in [11], the time between PEI and PO maybe shorter than the time for the UE to obtain the UL grant and transmit the early return indication. So in this case there is no gain to send the early return indication. |
| Ericsson | No | We first have to have a baseline that works. This, however, does not seem essential for the feature to work. |
| China Telecom | No | This will introduce more interaction between NW and UE, which may not have the benefits of early return when the gap is short. |
| Intel | May be not | NAS procedure timers are quite long – so the worst case gap requirement is much larger than typical delay. UE should be allowed to come back earlier if the procedure finished early.  On the other hand, network is unlikely to use CONNECTED for longer procedure.  For INACTIVE state, early come back is more useful.  The message depends on the state the UE was put in. If connected, the Assistance information can be reused in the same cell. If INACTIVE, normal ResumeRequest can be used. |
| Charter Communications | Maybe | Depending on the max gap to be considered, this optimization maybe useful. |
| Samsung | No | We think that explicit signalling for early return is not needed, which looks a tiny optimization. This optimization can become complex considering that practically there need to be a dedicated SR resource to send such early return. But we wonder whether UE is allowed to transmit during the gap if the UE has finished monitoring other SIM in case UL transmission (e.g. URLLC data arrival or some other event which trigger UL transmission) is needed. |
| ZTE | FFS | This can be further discussed which kind of Gap would be supported at last. |
| Xiaomi | No | We don’t think this could introduce much benefit. |
| DENSO | Maybe not | Agree with MediaTek.  For aperiodic gap, since the duration of a gap should be not so long, there is no much benefit. Additionally, if the duration is so long as early return makes significant benefit, maybe UE should use the switching to leave RRC\_CONNTECD  For periodic gap, if “early return” means releasing configured gap, it should be FFS as we can discuss based on another email discussion #243. |

**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?**

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| --- | --- |
| **Company** | **Comments** |
| Lenovo | After UE returns to the network A at the end of the gap, what information is sent by UE first? For example, if TAT expires at the end of the gap, random access should be performed first. |
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**Summary:**

TBD.

# Conclusions

TBD.

# References

1. R2-2100474 report on e-mail discussion [post112-e][256][Multi-SIM] Network switching details, vivo
2. R2-2105257 Network switching procedures for Multi-SIM Qualcomm Incorporated
3. R2-2105900 Network Switching Solutions for Multi-SIM Charter Communications, Inc
4. R2-2104765 UE Notification on Network Switching for Multi-SIM OPPO
5. R2-2105085 MUSIM Network Switching Apple
6. R2-2105086 MUSIM Band Conflict and RRC Processing Delay Requirements Apple
7. R2-2105165 Consideration on the Switching Notification Procedure ZTE Corporation, Sanechips
8. R2-2105195 Further Consideration on Network Switching CATT
9. R2-2105196 Analysis on UE switching without leaving RRC\_CONNECTED state China Telecommunications
10. R2-2105201 Network switching consideration of Multi-SIM China Telecommunication
11. R2-2105226 Scenarios and Requirements for switching notification procedure Nokia, Nokia Shanghai Bells
12. R2-2105270 Open Issues on Switching Notification vivo
13. R2-2105375 MUSIM Release Assistance Info for network switching ASUSTeK
14. R2-2105437 Open issues on network switching for Multi-USIM devices Samsung Electronics Co., Ltd
15. R2-2105442 Signalling design on short time switching procedure DENSO CORPORATION
16. R2-2105445 Procedures for MSIM UE notification on network switching Futurewei Technologies
17. R2-2105449 UE notification procedure for short time switching NEC
18. R2-2105450 Open issues on network switching procedures DENSO CORPORATION
19. R2-2105683 Discussion on Busy Indication in Inactive State Sony
20. R2-2105684 Discussion on Leaving in MultiSIM Sony
21. R2-2105719 On coordinated switch from NW for MUSIM device Huawei, HiSilicon
22. R2-2105823 Switching notification and busy indication Lenovo, Motorola Mobility
23. R2-2105977 Discussion on switching mechanisms for a Multi-USIM device Ericsson
24. R2-2106110 Considerations on SIM Swithcing LG Electronics
25. R2-2106212 RRC based Switching Notification for leaving RRC\_CONNECTED Sharp
26. R2-2106215 RNAU Handling in MUSIM Sharp
27. R2-2106351 Network switching behavior for MUSIM device MediaTek Inc.
28. R2-2106399 Discussion of the UE notification on network switching for multi-SIM Xiaomi Communications

# Annex

The following network switching related agreements were made in previous meetings.

RAN2#114-e:

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| --- |
| * 1: RRC signaling 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. * We support at least AS-based solution (with AS-based response) for network switching while leaving RRC\_Connected state in NW A. FFS if this may include NAS information * 1: AS -based solution for network switching includes two steps: 1-) If configured, UE can send an RRC message to leave RRC\_CONNECTED for MUSIM purpose 2-) gNB may release the UE to Idle/Inactive. * 2: Include the following RAN2#113bis-e agreement in the LS:   During switching procedure for leaving RRC\_CONNECTED state, UE is allowed to enter RRC\_IDLE state if it does not receive response message from network within a certain configured time period. FFS for RRC\_INACTIVE state   * 3: The “configured time” for AS-based solution for the UE to leave RRC\_CONNECTED without a response is configured by the gNB. Indicate RAN2 is still discussing this for AS-based solution in the LS. * 4: Indicate that RAN2 has not discussed the interaction between AS-based solution and any SA2 agreement on NAS messages or NAS-based solution for network switching. |

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.

2 During switching procedure for leaving RRC\_CONNECTED state, UE is allowed to enter RRC\_IDLE state if it does not receive response message from network within a certain configured time period. FFS for RRC\_INACTIVE state.

RAN2#113-e:

1 Switching procedure can be used to notify network A that the UE has a preference to leave RRC\_CONNECTED state in network A.

2 The switching procedure can be used to notify network A that the UE has a preference to be kept in RRC\_CONNECTED state in network A while temporarily switching to network B.