3GPP TSG-RAN WG2 Meeting #113-e R2-21xxxxx

Online, Jan 25 – Feb 05 2021

**Agenda item: 8.3.3**

**Source: vivo**

**Title: [DRAFT] [post112-e][256][Multi-SIM] Network switching details (vivo)**

**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#112e:

* [Post112-e][256][Multi-SIM] Network switching details (vivo)

Discuss further details of network switching.

Intended outcome: Email 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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## General

One of the objectives of MUSIM WID [1] is following:

|  |
| --- |
| 1. Specify mechanism for UE to notify Network A of its switch from Network A (for MUSIM purpose) [RAN2]:  * RAT Concurrency: Network A is NR. Network B can either be LTE or NR. * Applicable UE architecture: Single-Rx/Single-Tx, Dual-Rx/Single-Tx   NOTE 1: Single Rx allows MUSIM UE to receive traffic from only one network at one time, Dual Rx allows MUSIM UE to simultaneously receive traffic from two networks. Single Tx allows MUSIM UE to transmit traffic to one network at one time, dual Tx allows MUSIM UE to simultaneously Transmit traffic to two networks. (The terms Single Rx/Tx and Dual Rx/Tx do not refer to a device type. A single UE may, as an example, uses Dual Tx in some cases but Single Tx in other cases). |

In RAN2#112-e, the following network switching related agreements were made.

* RAN2 will continue to discuss RRC-based switching/leaving and returning procedure in 5GS/NR when UE is in RRC\_CONNECTED. There may be different mechanisms (short/long, leaving/returning, etc.).
* RAN2 will evaluate short/long time switching in this WI.
* From RAN2 point of view, it is feasible that the busy indication is sent as an RRC message with security for RRC\_INACTIVE. FFS how this works. FFS if/how to ensure UE doesn't disconnect from RRC\_CONNECTED during busy indication.

In this email discussion, we will focus on the above remaining issues.

**Short/long time switching:**

After the Multi-USIM UE sends RRC switching notification in network A and switches to network B, it is not clear what is difference between short and long switching. According to the contributions submitted in RAN2#112-e, the following RRC states difference after sending switching notification were discussed:

* RRC\_CONNECTED [5,6,7,8,9,10,11,15,18]
* RRC\_IDLE or RRC\_INACTIVE [4,5,6,7,11,13,14,15,16,17,18]

Based on contributions summaries, in the rapporteur's understanding, for the short-time switching, such as paging monitoring in network B, UE should be kept in the RRC\_CONNECTED in network A, to minimize the impact on the ongoing service in network A. While for the long-time switching, such as an initiated voice call in network B, it would be better to move the UE into RRC\_IDLE or RRC\_INACTIVE in network A instead of keeping in RRC\_ CONNECTED.

As captured in RAN2 agreements, there may be different mechanisms (short/long, leaving/returning, etc.). In the following sections, the term long-time switching procedure is used for the switching notification procedure which moves the UE to RRC\_IDLE/RRC\_INACTIVE in network A, while the term short-time switching procedure is used for the switching notification procedure which keeps the UE in RRC\_CONNECTED.

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

1. **Do companies agree with the assumption that the long-time switching procedure can be used for the switching notification procedure which moves the UE to RRC\_IDLE/RRC\_INACTIVE in network A, after sending switching notification to network A?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Ericsson | No, but | We agree that the UE may end up in RRC\_IDLE/INACTIVE but this is ultimately a network decision. Hence, the current formulation may be misleading. It seems what we would want to state is actually “long-time switching procedure can be used to notify network A that the UE has a preference to leave RRC\_CONNECTED state in network A”. |
| Sharp | Agree with the intention, but | We prefer the wording from Ericsson that “long-time switching procedure can be used to notify network A that the UE has a preference to leave RRC\_CONNECTED state in network A”. |
| OPPO | Agree with the intention, but | No matter for short/long-time switching, which state the UE will be moved is more like a network implementation. It’s up to which type of info is added into switching notification message, so we should directly discuss which content is added into switching notification message instead of clarifying the possible network implementation.  More addition, we also think the UE may move to RRC\_IDLE/INACTIVE autonomously without waiting for network response for long-time switching, this methed should also be considered. |
| CATT | Agree with the intention, but | Agree with Ericsson that whether the UE could enter RRC\_IDLE/RRC\_INACTIVE is the network implementation, the wording could be improved. |
| vivo | Agree with the intention | Further, We agree with the wording of Ericsson: “The long-time switching procedure can be defined as the switching notification procedure which moves the UE to RRC\_IDLE/RRC\_INACTIVE in network A, after sending switching notification to network A” |
| Apple | Agree with the intention | From the UE perspective, we feel that the impending procedure on Network B should not be delayed inorder to allow for the Network A to signal a RRC Connection Release to the UE. In such cases, to avoid such delay, we agree with Ericsson wording that “long time switching procedure can be used to notify network A that the UE has a preference to leave RRC\_CONNECTED state in network A” and that network A on receipt of such a request would consider the UE to have moved out of RRC\_CONNECTED. This way, UE can autonomously trigger a local release of the RRC connection to handle the long time switching to Network B. |
| Samsung | Agree with the intention, but | We agree with the suggested re-wording from Ericsson. We think that which contents on UE’s preference to leave RRC\_CONNECTED state and when/how to move RRC\_IDLE/INACTIVE state can be further discussed in next questions. |
| LG | Agree with the intention | We also fine with Ericsson’s wording. This is definitely up to the network decision whether the UE moves to RRC\_IDLE/INACTIVE. |
| ASUSTeK | Agree with the intention | We agree with the wording proposed by Ericsson. |
| Fraunhofer | Agree with the intention | Agree with OPPO and Ericsson. The manifestation of both long and short-time switching should be dependent only on the content in the indication and not tied to RRC state. Ultimately for both long and short time switching, a common framework with should be defined. In which, the UE indicates to the network about the type of leaving. It is then upto network implementation to make decisions on RRC state, scheduling etc |
| Huawei, HiSilicon | No, but | The definition of “long-time switching” and “short-time switching” is not clear and these terms do not indicate the key characteristic of the events that trigger the UE’s switching. Instead of using such terms, we prefer to categorize the events as below:   * Group 1: The event for which the instant of activity in NW B is unpredictable, such as initiating TAU/RNAU or voice call in NW B. * Group 2: The event for which the instant of activity in NW B is predictable * Group 2-1: The event that occurs periodically, such as paging reception or serving cell measurement in NW B. * Group 2-2: The event that is triggered conditionally, such as measurement for cell reselection or SI acquisition in NW B.   We understand the intention of procedure in section 2.2 is for the switching that is triggered by Group 1 events, while section 2.3.1 is for the switching that is triggered by Group 2-1 events and section 2.3.2 is for the switching that is triggered by Group 2-2 events.  In addition, we agree with other companies that it is up to NW decides the UE’s RRC state, UE’s preferred state is helpful for the NW to make such a decision. |
| MediaTek | Yes | We know that typically UE RRC state should be decided by the network. However, for long-time switching, UE may need to switch to Network B even without receiving RRC Release from Network A, if the traffic in Network B is considered more important. Therefore, we need a mechanism for UE to move to RRC\_IDLE/INACTIVE autonomously even without network response. |
| ZTE | Yes | We agree with the intention, and we also agree that this is ultimately a network decision.  Furthermore, we also want to mention that SA2 has defined some assistance information for the MT restriction as below in 23761:  - Information to temporarily restrict/filter MT data/signalling handling:  - An indication that the UE should only be paged for voice (MMTel voice or CS domain voice (for EPS)), or  - An indication that the UE should not be paged at all, or  - PDN connection(s) for MT notification/paging restriction.  Thus, we think for the long leaving, the UE enters into Idle/Inactive state, this assistance information shall be send to the network, considering that this information is transparent to the AS layer, maybe it’s better to adopt a NAS signaling for the long leaving procedure. |
| Xiaomi | Agree with the intention, but | Agree with the rewording of Ericsson. |
| SONY | Agree with the intention | Agree that the goal from the UE is to be released to RRC\_IDLE or RRC\_INACTIVE state, but it is up to the NW. If not released the UE behavior will be up to the UE implementation. |
| Convida | Agree with the intention but | Agree with Ericsson that whether the UE could enter RRC\_IDLE/RRC\_INACTIVE is up to network implementation. We prefer the wording from Ericsson that “long-time switching procedure can be used to notify network A that the UE has a preference to leave RRC\_CONNECTED state in network A”. We also share OPPO’s views. |
| Charter Communications | Agree, but … | To allow final decision by the network, we prefer the language suggested by Ericsson, with the following clarification: “long-time switching procedure can be used to notify network A that the UE has a preference to leave RRC\_CONNECTED state in network A for network B”.  Echoing comments by several companies that short/long-time switching are not formally defined, we suggest to formalize the definition as follows:  **Short-time switching:** where the UE switches either RX-only for a short duration (e.g. for paging and cell measurement on network B), or switches TX and/or RX for a short duration (e.g. for TAU/RNAU or to send busy indication on network B). The upper and lower bounds of the switch are FFS. CN may not have visibility into switching at RAN-level.  **Long-time switching:** where the UE switches TX and/or RX for a long duration (e.g. to initiate a PDU session on network B). CN is aware that UE performs long-time switching. |
| NEC | Agree with the intention, but | Agree with companies above that the wording should be improved. |

**Summary:**

TBD.

1. **Do companies agree with the assumption that the short-time switching procedure can be used for the switching notification procedure which keeps the UE in RRC\_CONNECTED in network A, after sending switching notification to network A?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Ericsson | No, but | We agree that the UE may stay in RRC\_CONNECTED but this is ultimately a network decision. Hence, the current formulation may be misleading. It seems what we would want to state is actually “short-time 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”. |
| Sharp | No | We think the state is incomplete for that the leaving behavior is not included. Currently, at least the periodic short-time switching should be supported for UE to perform paging reception on network B. Similar to measurement gap, periodic short-time should be configured by NW A without UE indication for each leaving to reduce signaling overhead. So “used to notify network A” from Ericsson’s state may be not suitable for periodic short-time switching. May be we can state it as “short-time switching procedure can be used for the switching notification procedure which keeps the UE in RRC\_CONNECTED in network A while temporarily switching to network B”. |
| OPPO | Agree with the intention, but | The similar comments as Q1 |
| CATT | Agree with the intention, but | The similar comments as Q1 |
| vivo | Agree with the intention | We agree with the wording of Ericsson. Furher a rewording can be: “Short-time 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 (periodically) switching to network B” |
| Apple | Agree | We would like to reduce as much as possible any potential RRC Connection Setup procedure again on network A, once the short switching procedure is completed on network B. We would prefer if NWs could distinguish the case of short Vs long switching to help UEs to stay in RRC CONNECTED for short switching cases atleast, and network A do not schedule any activity (both UL and DL) to the UE during these periods when UE does short switching to network B. |
| Samsung | Agree with the intention, but | We agree with the suggested re-wording from Ericsson. We think that which contents on UE’s preference to be kept in RRC\_CONNECTED state and how to stay in RRC\_CONNECTED while temporarily switching to network B can be further discussed in next questions. |
| LG | Yes with intention | However, considering that the scheduling gap is periodically working like the measurement gap, the wording of sending a notification to network A needs to be clarified more. This is because, if asking scheduling gap can be regarded as sending a notification, the UE may not ask the scheduling gap everytime after entering the scheduling gap. |
| ASUSTeK | Agree with the intention | We agree with the wording proposed by Ericsson. |
| Fraunhofer | Agree with the intention | Similar to Q1 |
| Huawei, HiSilicon | No, but | See our comments in Q1. |
| MediaTek | Agree with the intention, but | It’s a network decision and it’s not only about RRC state. For example, Network A may provide periodic scheduling gaps for UE to perform short activities in Network B, in this case UE is kept in RRC\_CONNECTED. But if UE sends some kind of “switching request”, Network A may consider sending UE to RRC\_IDLE/INACTIVE because it’s hard to estimate how much time UE needs to be away. |
| ZTE | Yes | We agree with the intention, and we also agree that this is ultimately a network decision.  Furthermore, it would keep the UE in the RRC\_Connected state, thus it’s better to take the RRC signalling for the short leaving procedure. |
| Xiaomi | Agree with the intention, but | Agree with the rewording of Ericsson. |
| SONY | Yes, agree with intention | There are different levels on short-time leaving which needs to be discussed. It should be possible for a UE to be configured with periodic gaps for receiving paging from NW B without leaving the RRC Connected state in NW A, similar to measurement gaps.  Slightly larger gaps, e.g. when sending a NAS busy indication and waiting for the respons should also be possible to have without leaving the RRC Connected state but the UE behavior as well as the NW behavior need to be discussed further. |
| Convida | Agree with the intention but | Same comments as in Q1. Additionally, we have a preference for the rewording from Ericsson as captured above. |
| Charter Communications | Agree, but | Agree that during short-time switching the UE stays in RRC connected state. However, periodic short-term switching may be implemented via a solution built on existing mechaisms, e.g. measuremet gaps, where UE may not send any notification. |
| NEC | Agree with the intention, but | Agree with companies above that the wording should be improved to inclue the switching behavior instead of just the notification behavior. |

**Summary:**

TBD.

## Long-time switching procedure

According to [4,5,6,7,11,12,13,14,15,16,17,18], the general framework of long-time switching procedure in network A can be given by Figure 1, which includes a Switching Notification message and optionally a Response message(i.e. RRCRelease). The procedure in Figure 1 does not exclude reusing existing message (e.g. UEAssistanceInformation with ReleasePreference) as Switching Notification message.



**Figure 1 RRC-based long-time switching procedure**

**Switching Notification message:**

Regarding the content of Switching Notification message, the below options are proposed in contributions:

* **A**: **Switching cause** [9,12,18], which is used to indicates the behavior in network B causing the switching, such as TAU, RNAU, busy indication, etc.
* **B**: **preferred RRC state** (RRC\_IDLE or RRC\_INACTIVE)[4,12,13,14,16], indicates the target RRC states in network A after switching.
* **C**: **Duration of switching** [12], e.g. could be the time expected by the UE that will be away from network A, or an indication to distinguish short-time and long-time switching.
* **D**: **Other info**, if any, please specify.

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

1. **What information (A, B, C, D) should the Switching Notification Message carry in case of the long-time switching?**

|  |  |  |
| --- | --- | --- |
| **Company** | **A/B/C/D/E** | **Comments** |
| Ericsson | C | Besides the information already agreed in SA2, a long-time switching notification could contain information about the switching duration, e.g. it could indicate whether the switching is for a *limited* or *extended* duration (maybe better to not refer to the indication in C as short-time and long-time duration to avoid confusion with the long-time and short-time switching we have in sections 2.2 and 2.3). Moreover, we have to further discuss later whether this information should be carried over NAS or RRC. |
| Sharp | B | For MUSIM UE, we think it is the baseline that if UE dicided to switch from NW A to NW B, NW A should follow UE’s indication. So, what UE needs to do may be just indicate its preferred RRC state. But it should be up to NW about whether release UE to INACTINVE or IDLE. |
| Oppo | B | Option B can be the baseline and further optimization can be considered if needed, e.g. UE may move to RRC\_IDLE/INACTIVE autonomously without waiting for network response. |
| CATT | B | The UE could request for the preferred state to the network, but the network could have its own decision about whether to release the UE to INACTIVE or to IDLE.  To choose this option, maybe specific procedure is not needed. IE “*releasePreference”* in message *UEAssistanceInformation* could be reused. |
| vivo | A or A+B | As mentioned in Q1, UE indicates its preference to leave from connected state in netowrk A with long-time switching procedure and the network A can make the final decision. Hence, the network A needs some information, e.g. switching cause (Option A), to determine whether the UE should be released.  In addition, preferred RRC state (Option B) stands for the UE’s expectation, it may be useful for network A to determine UE’s state.  Considering it is relatively difficult for UE to estimate an exact duration of switching. Option C is not preferred |
| Apple | C/B/A | We feel that all the three options would work, and can be candidate solutions. For example, Option C would be the most straightforward to allow the UE to resume back within a given negotiated time duration for long-time switching if UEs would like to avoid immediately being moved to RRC IDLE or RRC INACTIVE states as part of a long-time switching. Option B is preferred if UE is not able to deterministically estimate the duration of the long-time switching, and hence would request for a transition to either RRC IDLE or RRC INACTIVE states. Option A would leave the NW to drive the susbquent course of action, based on the switching cause indicated by UE. |
| Samsung | B with comments | We understand that SA2 has discussed NAS based solution for long-time switching procedure, thus it would be good to first discuss whether RRC or NAS based solution is used for long-time switching procedure. This could avoid back and forth discussion between RAN2 and SA2, which is time consuming. Even though both solutions are more or less the same except which signalling is used, NAS may be in a better position to judge whether to trigger long-time switching procedure with more detailed information.  If RRC signalling is used for long-time switching procedure, we think the preferred RRC state is enough. We also would like to point out that the preferred RRC state for long-time switching procedure (if introduced) and legacy one for power saving are independent features e.g. UE may implement only one feature so new IE needs to be defined. |
| LG | B, C | Duration of switching helps efficiency for data scheduling because the network can expect when the UE will come back.  We think, even in the case of long time switching, the network may decide to keep RRC state as RRC\_CONNECTED if the UE’s expected duration of switching isn’t too long in the network perspective. Thus, we think the UE needs to indicate not only the duration of switching but also the preferred RRC state to keep RRC\_CONNECTED state. |
| ASUSTeK | C | According to the conclusion made by SA2, the switching notification message should provide information to assist network to block paging to the UE during the UE leaving. Therefore, information to help network to decide duration of the blocking is needed and the network could make the decision based on option C. |
| Fraunhofer | A, B  C => with comments | Option A, we agree with Apple. This might be a useful feature to inform the incumbent network about scheduling decisions and help improve network statistics.  For Option B, we agree with Sharp and CATT  For Option C, as Ericsson pointed out, depending on the type of the indication i.e., RRC or NAS, this might need to be coordinated with SA2. As in the SA2 solution using NAS indication, in addition to duration, the UE can also indicate the preferred (or not-preferred) MT PDU sessions |
| Huawei, HiSilicon | B | As we explained in Q1, we think this procedure can be used for the switching triggered by Group 1 events.  Option B is enough to help the gNB to determine the RRC state that UE transits to. |
| MediaTek | B | We have similar procedure in Rel-16, which can be reused here. |
| ZTE | FFS | Share the same view as many other company that “SA2 has discussed NAS based solution for long-time switching procedure, thus it would be good to first discuss whether RRC or NAS based solution is used for long-time switching procedure. “  Furthermore, considering that it has been agreed at SA some assistant information (e.g. PDN connections for MT notification/paging restriction) for the MT restriction shall be sent to the network, we prefer to adopt the NAS based procedure  For the leaving state, we think it’s left to the network to determine the Idle/Inactive state.  For the switching cause, first, whether TAU, RNAU, busy indication belong to the Long-leaving is still FFS, even the UE trigger long-leaving procedure for TAU, RNAU, we still don’t see motivation to indicate the cause.  For the duration of switching, we think if NAS signalling is adopted for long-leaving while AS signaling for short leaving, there is no need to indicate the Duration. |
| Xiaomi | B | Option B should be considered as the baseline. Also, we think we don’t need to define a totally new IE for this Switching Notification message and we should reuse R16 IEs/messages as much as we can. |
| SONY | B | A long time switching should be the same as leaving the RRC Connected state in the NW (Release or Suspend). When the UE wants to enter RRC Connected state again it should make a random access, as in legacy. |
| Convida | B, C |  |
| Charter Communications | FFS | RAN2 is expected to follow SA2’s lead on long-time switching. Given SA2 has extensively discussed long-time switching, we should let SA2 decide on appropriate solution (NAS-based or RRC-based solution).  To allow the UE to have the capability to selectively terminate PDU sessions during long-time switching, a NAS-based solution is preferred.  We believe that (B) could prove beneficial for the network in deciding UE’s eventual state. |
| NEC | B | Option B should be supported as baseline. The UE provide preferred RRC state to the network, but the final decision is up to network. |

**Summary:**

TBD.

**Response message:**

After sending the Switching Notification Message in network A, there are different understandings on whether the RRCRelease message is mandatory for the UE to switch to network B.

Some papers [7, 15] propose the UE switches only after receiving a network response for Switching Notification Message, to ensure full control of network and allows the network A to release the multi-SIM UE to RRC\_INACTIVE if needed.

Autonomously/local release of the RRC connection after sending switching notification is proposed in [4, 18]. The argument is in Multi-USIM scenario if the UE decides to leave network A, it is better to leave and initiate the setup with network B as soon as possible to initiate the intended service. In this case, requiring the UE to wait for the RRC release message from network A seems not practical, especially considering that network A may decide not to give any response to the UE. Hence, allowing the UE to autonomously release RRC connection may be more appropriate for Multi-USIM device.

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

1. **After sending switching notification message, whether UE is allowed to perform switching without the reception of RRCRelease message?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Ericsson | No | If the UE is in RRC\_CONNECTED in Network A it may have data scheduled in Network A, hence the UE cannot judge alone on whether to leave Network A or not and should wait for a decision from Network A. The network may also decide to move the UE to RRC\_INACTIVE instead of RRC\_IDLE, but such decision must be conveyed in the *RRCRelease* message. Even in the case where the UE would always be moved to RRC\_IDLE in Network A, it may lead to state mismatch between the UE and the network if the UE performs this action without an *RRCRelease* message. |
| Sharp |  | For MUSIM UE, we think it is the baseline that if UE dicided to switch from NW A to NW B, NW A should follow UE’s indication. The case that UE sends an indication but no response received could be considered as an exception, what should UE do in such case may left for UE implementation. |
| Oppo | Yes within a timer | After sending switching notification message, it’s more flexible to leave it to UE implementation whether it’s needed to wait for RRC release message; but from network perspective, it’s more desirable to control UE in a predictable way, so to balance the requirements between UE and network, UE can wait in network A for Response Message within a certain time, after that, UE behaviour is up to implementation. |
| CATT | Yes | It could be more a UE’s preference about whether to leave the network A and connect to the network B. So based on Q3, if option B could be agreed, the UE could perform switching without the reception of RRCRelease message. |
| vivo | Yes | UE should be allowed to perform switching without the reception of *RRCRelease* message.  For example, if the UE is performing ftp downloading in NW A when a voice call occurs in NW B. Considering the voice call is more delay-sensitive and has higher priority than the ftp downloading, it is better for the UE to leave NW A and initiate the connection setup with NW B ASAP. Thus, the reception of *RRCRelease* message should not be be mandatory on the UE switching. |
| Apple | Yes (with a Timer if needed) | Agree that having a RRCRelease message would ensure a clean switch from Network A to Network B. But the question is what if there is a delay from Network A to indicate the RRCRelease ? From a MUSIM UE perspective, it would be reasonable for the UE to expect that NW is always going to agree to the UE request to switch. If the concern is about state mismatch as Ericsson has indicated, some protocol behavior can be mandated in UE side to ensure RRC state sync between UE and NW. One option is to have a timer based implementation limiting the maximum waiting time for receiving the RRCRelease message, and if none is received withing timer expiry, UE proceeds to switch to Network B. |
| Samsung | No | Agree with Ericsson. |
| LG | No | Agree with Ericsson |
| ASUSTeK | Yes | Local release of the RRC connection should be supported, especially when the switching is due to delay-sensitive service. |
| Fraunhofer | No | In general, the MUSIM UE connected to network A should not be switch without a response. Depending on the operation that needs to be performed in network B, the MUSIM UE might be forced to switch. This can however be based on implementation and need not be specified. |
| Huawei, HiSilicon | Yes | In Multi-SIM scenario, if the UE decides to leave the current network, it is better to leave and initiate the setup with another network as soon as possible to start the service. The latency introduced by response message may not be acceptable. |
| MediaTek | Yes | After sending the switching notification, local release in Network A should be allowed if UE does not receive network RRC Release after some timer expires. This is becuase UE needs to do something in Network B. |
| ZTE | FFS | We think at least the UE shall guarantee that the notification message has been received by the network (e.g. L2 ACK) before the switching. |
| Xiaomi | FFS | Agree with ZTE. |
| SONY | Yes, based on a timer | The UE has decided to leave the NW for another NW and the current NW A should not delay that more than necessary but a release response is preferred. |
| Convida | Yes, based on a timer | As suggested by OPPO. |
| Charter Communications | No, but use a timer in case of … | It’s best if the UE waits for RRCRelease message to avoid state mismatch between the UE and Network A. However, UE switching without waiting for RRCRelease message should be considered as error scenario, i.e, switching occurs only after a configurable timer expiry. |
| NEC |  | We think basic assumption is that the network responds the release request, once the network receives it, i.e. it is network responsibility to let the UE switch to the other RAT as soon as possible. The delay of a response message can be seen as a abnormal case, it can be up to UE implementation. |

**Summary:**

TBD.

UE may fail to receive the Response Message in some cases, e.g. due to bad link quality or network A decides not to give any response to the UE. To handle the Response Message missing case, timer-based RRC release is discussed in [14,17]. In this solution, UE starts a timer while sending the Switching Notification Message in network A, and initiates a local RRC connection release procedure upon the timer expires if no response is received from network A.

If **Yes** is selected for **Q4**, please further indicates which of the following is preferred.

**Option1: UE waits in network A for Response Message within a certain time**

**Option2: UE performs local release immediately after sending the switching notification message**

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

1. **If the ANS to Q4 is Yes, which detailed option is preferred?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1/2** | **Comments** |
| Oppo | Op1 | See the answer in Q4 |
| CATT | Op1 | A timer could be used to allow the UE to receive the RRCRelease message, but if the timer is expired, the UE could directly switch to network B. |
| vivo | Option 1 | The below factors need to be balanced:   * UE needs to perform the switching to NW B ASAP in case of latency-sensitive services(e.g. voice call); * UE needs to stay in NW A as long as possible to ensure the reception of *RRCRelease* to keep state match between UE and NW A.   Therefore, we suggest that UE performs local release if UE cannot receive the NW response in a certain duration after sending the switching notification message. We can further discuss whether a timer needs to be specified/configured later. |
| Apple | Option 1 | See answer to Q4 above. |
| ASUSTeK | Option 1 | We are fine with option 1. Regarding option 2, it depends on whether the timer is configurable. If the timer could be set to 0, option 2 is supported as well. |
| Huawei, HiSilicon | Op1 | A timer would be helpful for transiting UE to RRC\_Inactive state. If the NW prefers to transit the UE to RRC\_Inactive state, the NW can send the *RRCRelease* message with *suspendConfig* within a certain time and UE performs as NW indicates. If no *RRCRelease* message is received within a certain time, the UE transits to RRC\_Idle state. |
| MediaTek | Option 1 | See answer to Q4 above. |
| ZTE |  | As answered in Q5, we think at least the UE shall guarantee that the notification message has been received by the network (e.g. L2 ACK) before the switching. |
| Xiaomi | None | Agree with ZTE |
| SONY | Op1 | See the answer in Q4 |
| Convida | Op1 | See feedback in Q4 |
| Charter Communications | Option 1 | As in Q4, UE switching without waiting for RRCRelease message should be considered as error scenario, i.e, switching occurs only after a configurable timer expiry. |

**Summary:**

TBD.

Companies are invited to express their view if any other comments or suggestions on the solutions for long-time switching procedure.

1. **Any comments or suggestions on the solution for long-time switching procedure?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LG | Even though the UE thinks a long time switching procedure is required, the network may think differently and can configure the scheduling gap for the switching procedure maintaining RRC Connection. Thus, even in a long time switching procedure, we think RAN2 needs to consider whether the RRC Connection can be maintained. |
| ZTE | According to the above discussion, for the long leaving, the UE will enter into Idle/Inactive state, but we are still not sure for which cases the long-leaving procedure would be adopted. It seems that there would be 2 ways:   1. Ran2 don’t specify dedicated cases that shall trigger the long-leaving, instead, it’s left to UE implementation 2. Ran 2 specify the dedicated cases that shall trigger the long-leaving.   If go to the option 2, according to the reference papers: there would be 6 leaving Scenarios:  Scenario 1: periodic switching, such as paging reception, serving cell measurement  Scenario 2: Measurement for the cell reselection  Scenario 3: SIB1 receiving or the Other SI receiving of the neighbor cell/Serving cell  Scenario 4: RRC triggered CP plane procedure, such as RAU; upper layer triggered CP plane procedure, e.g. TAU/Other MO signalling e.g.SMS  Scenario 5: CN/Ran paging response (e.g. busy indication)  Scenario 6: MO data/call service (including the Idle/Inactive state)  It’s clear that scenarios 1/2/3 shall belong to the short leaving (one-shot or periodic), the scenario 5 shall belong to the short leaving, the scenario 6 belong to the long leaving, but it’s not clear that whether scenarios 4 belong to long leaving or short one-shot leaving, It seems that for the scenarios 4, it’s better to left to the UE implementation, e.g. there are only non-GBR bearer, the UE can adopt long-leaving procedure, otherwise, adopt short leaving procedure. |
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**Summary:**

TBD.

## Short-time switching procedure

Short-time switching procedure can be used for short time activities in network B, includes paging reception, measurements, TAU, RNAU, etc. To facilitate the detailed solution discussion, we can further categorize the short-time switching scenario based on whether the activity which triggers the switching is a periodic event or not, as below.

**1. Periodic Short-time Switching**

The periodic short-time switching is triggered by some periodic activities on network B, such as paging reception, Measurements performing.

**2. One-shot Short-time Switching**

The one-shot switching is triggered by one-shot activities on network B, which may include reception and/or transmission, such as measurement for cell reselection, system information acquisition, etc.

To support the above 2 types of switching, both periodic short-time switching and one-shot short-time switching are proposed. The two procedures will be discussed in the following sections.

## Periodic short-time switching procedure

When UE is in RRC\_CONNECTED state on network A, the periodic short-time switching is triggered by the periodic activities on network B, including paging reception, measurements, etc.

Some companies discussed potential solutions for periodic short-time switching. [4] pointed out that the UE does not have to send the switch notification every time for the periodic event. [5] thought that the periodical duration for the periodical leaving can be considered.

[6, 7, 9, 10, 11] proposed mechanism of scheduling gap. In [9], it was proposed that a short gap (like in legacy measurement gap) can be applied to paging reception. The mechanism of scheduling gap could contain gap negotiation and gap configuration.

The following Figure 2 shows a candidate general framework of periodic gap negotiation and configuration.

1. UE sends short-time switching notification to request gap for multi-SIM purpose.
2. The network provides the gap configuration via RRCReconfiguration message.
3. UE sends RRCRecnfigurationComplete.



**Figure 2 Periodic short-time switching procedure**

Note: The Switching Notification in Figure1/2/3 may be the same or different RRC messages. The details of which RRC message to be used for switching notification can be discussed later.

1. **Do companies think the procedure in Figure2 is suitable for periodic short-time switching, which contains the switching notification message and RRC Reconfiguration procedure to configure gap?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Ericsson | No | There may not be a need for a short-time switching procedure in case the UE can perform such short time activities within the gaps that the network may already have configured. In case such short-time switching mechanism is really needed, the overall description above would be ok, i.e. the UE may indicate preference for certain gaps and the network may reconfigure the UE based on this. |
| Sharp |  | We agree with Ericsson that configuration of periodic short-time switching should be based on UE’s request. So, it could be a 2-step procedure, i.e., UE request a expected shechduling gap and NW configure the shechduling gap. |
| Oppo | Yes | We agree the signalling flow in general, but this does not imply that any enhancement is needed for step 2/3. Maybe the exsisting mechanism can be reused for step 2/3. |
| CATT | Yes,but | But  1.maybe UE does not need to initiate the short-time switching procedure every time for the periodic event.We agree with Ericssion that it is feasible that a scheduling gap maybe configured upon UE enters connected mode,then the scheduling gap can be used for each periodic event.‎  2.The procedure in Figure 2 does not imply any new messages is necessary.reusing or enhancement to the existing messages could be possible. |
| vivo | Yes | The already configured gap cannot always meet the gap requirement for MUSIM purpose, e.g. the paging reception on network B may need a gap with different start time and/or repetition period. In this case, the above procedure in Figure 2 is needed for the UE to report the preference of the gap pattern for MUSIM purpose. |
| Apple | Yes | Agree witht the overall short time switching procedure |
| Samsung | Yes with comments | We agree with the proposed signalling flow, except that the UE needs to request its preferred periodic gap configuration in step 1 as NW has no idea how to configure it.  In addition, we think that the configured periodic gap at certain times may not be needed anymore. Thus, we are open to discuss whether the UE is allowed to request the release of configured periodic gap. |
| LG | Yes | We agree with the procedure generally but the legacy procedures can be reused to configure the gap period. |
| ASUSTeK | Yes | The UE could perform the request when necessary. |
| Fraunhofer | Maybe | Agree with Ericsson. However, the switching notification can be an optional feature to update for e.g., the gap configuration |
| Huawei, HiSilicon | See comments | As we explained in Q1, we think the intention of this procedure is for the switching triggered by Group 2-1 events.  For the switching triggered by Group 2-1 events, we slightly prefer to leave this to UE implementation to use the existing available gap in NW A to perform the paging reception in NW B.  If the majority think such procedure is necessary for the periodic switching, we can accept. However, the necessisity of step 2/3 needs further discussion. |
| MediaTek | No | Agree with Ericsson. We doubt the need of short-time switching notification. Short-time activities in Network B can be done in pre-configred gaps in Network A. |
| ZTE | Yes |  |
| Xiaomi | Yes, but | we don’t need to define totally new IEs/messages and we should reuse R16 IEs/messages as much as we can. |
| SONY | Yes maybe | It could be preferred that the existing procedures for creating the gaps are used. It shall however be clear for the UE what activities that are expected to be performed during the gaps. |
| Convida | Yes | Share the same view as Oppo |
| Charter Communications | No | Short-time switching maybe implemented by solutions such as measurement gaps, hence existing procedure, with potential enhancements, may be used. |
| NEC | Yes | Agree with the signaling flow for scheduling gap request. Once the scheduling gap is configured, the UE can perform short-time switch based on the configuration. |

**Summary:**

TBD.

Moreover, [11] proposed RAN2 to discuss the support of UE reporting pattern of availability and also the configuration of gaps for switching scenarios for the basic idle mode operation. [7] thought that AS based negotiated short time gaps are needed to support short time switching for multi-SIM purpose. Multi-SIM UE can request its preferred short time gap configuration to current network for short time activities on other network, and current network confirms/ configures it accordingly.

Considering UE performs paging reception on network B within the scheduled gap, and the paging receptions are periodic behaviors with fixed time positions, the assigned gap shall cover the paging reception at least. Hence, during gap requesting, UE can provide necessary gap requirement information to network A, such as the below contents:

1. Indication of Need for Gap e.g. UE may need for gap, or disable the need for gap (e.g. if the other SIM is disabled).
2. Gap pattern request, e.g. gap start time, gap repetition period, etc;
3. Others, if any, please comment.
4. **What content should the switching notification message carry for periodic short-time switching?**

|  |  |  |
| --- | --- | --- |
| **Company** | **A/B/C** | **Comments** |
| Ericsson | C | See comments on Q7. But if ever needed to introduce such short-time methods, one may use power saving framework for DRX assistance info for it. |
| Sharp | B | Without changing the paging mechanism, for the gap used by UE performs paging reception on network B, the paging patteren information in NW B should be indicate to NW A. Otherwise, the gap configured by NW A may not align with the paging occation in NW B. |
| Oppo | C | We slightly prefer to leave this periodic short time to UE implementation. For instance, RRM measurement gap /DRX off duration in network A. |
| CATT | B | The information of requesting gap pattern is needed, and the network could configure the gap for short time switching different from the gap configured for RRM measurement. |
| vivo | A, B | As answered to Q7, the already configured gap may not be suitable for MUSIM purpose. For example, paging reception in network B requires UE to switch away from the network A for a certain time from a strict timepoint periodically. If the already configured gap in NW A cannot cover the the interval required for paging reception, the paging reception in NW B cannot be performed with the already configured gap. In this case, the information of gap pattern for paging reception in NW B should be indicated to NW A.  In addition to request for a gap for MUSIM purpose, in some cases, a UE configured with gap for MUSIM purpose may want to release the gap pattern. For example, the user may disable a second USIM, e.g. to reduce the power consumption. In this case, a request to disable the need for gap is necessary. |
| Apple | B | Eventhough option A would also work, we feel option B provides more granularity in to the exact gap patterns. |
| Samsung | B, C | We think that the purpose of periodic gap configuration is not the same as legacy measurement gap i.e. the former one is for other network while the latter one is for current network. Introducing new gap configuration for periodic short-time switching is a cleaner approach while keeping the principle aligned to that of legacy measurement gap. Thus, at least the following contents can be considered i.e.   * gap offset * gap length * gap repetition period   We also think multiple periodic gap configuration are needed i.e. a single gap configuration may not be efficient to handle all fixed/semi-static idle mode operations in other network e.g. SIB, paging, or RRM measurements etc.  As commented in Q7, configured gap pattern release can be requested to network by UE. |
| LG | A, B | The UE may indicate that gap is needed for MUSIM operation including the preferred gap period and pattern for paging information in other SIM |
| ASUSTeK | C | The paging/measurement activity information in NW B should be indicate to NW A. How to indicate such information could be FFS. |
| Fraunhofer | A, B | Option A and Option B can also be combined to provide more information to network A thereby as mentioned before improving network statistics. |
| Huawei, HiSilicon | See comments | We slightly prefer to leave this to UE implementation to use the existing available gap in NW A to perform the paging reception in NW B.  If the majority think such procedure is necessary for the periodic switching, we are fine for Option B. But it should be possible for the UE to indicate the release of such gap. |
| MediaTek | C | Agree with Ericsson & OPPO that existing mechanism can be used. |
| ZTE | A/B/C | For the B, the duration shall also be reported, for the B or C we think the refer SCS shall also be specified, for that the start time was normally indicated by start FN/SFN/Symbol and the duration maybe indicated by the number of symbols, the referred SCS is also needed, e.g. the SCS of the initial BWP of the network A |
| Xiaomi | C | Agree with MediaTek. |
| SONY | B | It should be clear for both the UE and the NW that paging is received during a set of gaps. If measurement gaps are used for paging reception, without the knowledge of the NW RRM, the mobility may be suffering from the paging reading of the other SIM. |
| Convida | B |  |
| Charter Communications | B | To assist Network A to configure periodic gaps, the UE should provide the attributes of the periodic gap, and an indication if there is no further need for the gaps. We believe the existing procedures should be used/enhanced to convey such attributes. |
| NEC | B and C | The suggested gap patten shall be provided to the network. But the final gap configuration should be up to network implementation.  To reduce traffic interruption as much as possible, similar to per-FR measurement gap, per-FR scheduling gap can be supported. As the network A is not aware of the frequency range information of the network B, the UE can provide frequency range related information to network A. |

**Summary:**

TBD.

Companies are invited to express their view if any comments or suggestions on the mechanism of periodic short-time switching.

1. **Any other comments or suggestions on the mechanism for periodic short-time switching?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | 1. During the periodic Gap, whether the network shall avoid both uplink/downlink scheduling, or still can schedule UL/DL with lower UE capability? 2. Besides the paging reception, is there any other events that require periodic leaving?   We think at least the serving cell measurement of the other card is also need periodic leaving, but we are not sure about the neighbor cell measurement for the cell re-selection. According to the reselecton requirement in the 38133, it seems also belong to the periodic events and need periodic leaving. |
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**Summary:**

TBD.

## One-shot short-time switching procedure

[5, 8, 11] proposed the mechanism of one-shot short-time switching. [11] thought that Cell Reselection and System Information monitoring in network B would require longer gaps than the gaps applicable for idle mode paging monitoring and serving cell measurements, and proposed that one way switching notification with the cause value at RRC or lower layers can be configured for leaving the network for extended idle mode monitoring in network B. [8] discussed that additional enhancements may be needed for example to handle aperiodic events such as paging response or TAU/RNAU based on the scheduling gap mechanism. [5] thought that one-shot leaving duration based on UE request would be supported.

The following Figure 3 shows a general framework of one-shot short-time switching. We will discuss it step by step.

1. UE sends one-shot short-time switching notification.
2. The network sends the switching response message, if needed.
3. UE sends a return message, if needed.



**Figure 3 one-shot short-time switching procedure**

During one-shot gap requesting, UE may provide necessary gap requirement information to network A, such as:

1. Gap pattern requested, e.g. gap length, gap start time.
2. Gap request cause, e.g. Cell Reselection or System Information, etc.
3. Others, if any.

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

1. **What content should the switching notification message carry for one-shot short-time switching?**

|  |  |  |
| --- | --- | --- |
| **Company** | **A/B/C** | **Comments** |
| Ericsson | C (same information used for periodic short-time switching) | Since those one-shot short-time operations should not be time critical, we see no need to differentiate between one-shot and periodic short-time switching. If one defines a periodic switching it may as well be used for one-shot short-time switching. The UE can wait for the short-time switching configuration for periodic events. |
| Sharp | A | The procedure used for one-shot short-time switching should be same as periodic short-time switching. |
| Oppo | A |  |
| CATT | A | Network A do not need to know the detailed gap request cause.  Moreover,the procedure for one-shot short-time switching and Periodic short-time switching can be unified to one procedure. |
| vivo | A |  |
| Apple | A | Similar to Option B for Question 8 |
| Samsung | A | We think that same contents in Q8 can be considered without gap repetition period for one-shot short-time switching procedure. |
| LG | C | Same information like our response to Q8. We think a common procedure can be used regardless of the one-shot short time or periodic switching. This is because, even in the case of one-shot switching, the UE anyway need to perfrom periodical short time switching procedure to monitor paging later. |
| ASUSTeK | C | We agree with Ericsson’s comment. |
| Fraunhofer | A, B | Similar to Q8 |
| Huawei, HiSilicon | See comments | As we explained in Q1, we think the intention of this procedure is for the switching triggered by Group 2-2 events.  For the switching triggered by Group 2-2 events, we slightly prefer to leave this to UE implementation to use the existing available gap in NW A to perform measurement for cell reselection or SI acquisition in NW B.  If the majority think such procedure is necessary for the one-shot switching (maybe also for the periodic switching), we prefer a unified procedure and with the same information as the periodic switching, i.e. gap start time, gap repetition period, and the possibility of indicating the release of such gap. |
| MediaTek | C | Agree with Ericsson. |
| ZTE | FFS (Maybe A/B/C) | Before determining which assistance information were needed, we think it’s better to clarify which events would trigger the one-shot short leaving.  According to the submitted papers in the last meeting, for the following events, it may need one-short leaving, in which the Scenario 2 and 4 are FFS.  Scenario 2: Measurement for the cell reselection  Scenario 3: SIB1 receiving or the Other SI receiving of the neighbor cell/Serving cell  Scenario 4: RRC triggered CP plane procedure, such as RAU; upper layer triggered CP plane procedure, e.g. TAU/Other MO signalling e.g.SMS  Scenario 5: CN/Ran paging response (e.g. busy indication)  Then we also need to discuss which kind of Gap shall be adopted, according to the submitted papers in the last meeting, there would be 3 options:   * Option 1: Scheduled Gap,the Gap length equals to the short leaving duration, during the Gap the network shall avoid both DL and UL scheduling;     (Note: It doesn’t preclude that for the dual-Rx UE, it can adopt the reduced Rx capability for the DL scheduling for the scenario 2/3)   * Option 2: Scheduled Gap with TDM pattern, which is similar to the measurement GAP, the network A reserve the Gap periodically during the leaving duration      * Option 3: Autonomous Gap, during the Gap, just as some legacy MUSIM UE has done, it’s left to the UE implementation on how to communicate with 2 networks.     Once these questions were clarified, we think it’s would be much easier to determine which assistance information was necessary |
| Xiaomi | C | Agree with Ericsson |
| SONY | A | Longer one-shot gaps are needed for e.g busy indication and paging collision avoidance, when the UE needs to wait for a confirm including e.g. a new 5G-GUTI. |
| Convida | A |  |
| Charter Communications | C | Agree that one-shot short-time switching should be considered, but we suggest not to consider Fig 3 as a new procedure, rather to use existing solutions to implement the exchange shown in Fig 3. For instance, the same periodic short-time switching procedure should be used for one-time short-time switching with possibility for extension of the switching time to accommodate for events other than paging monitoring.  Alternatively, UEAssistanceInformation RRC signaling can be reused for one-shot short-time switching where a UE can inform gNB of the expected duration that tunes to network B, along with any reducated TX/RX capability that UEAssistanceInformation supports. |
| NEC | A |  |

**Summary:**

TBD.

Regarding the switching response message in one-shot short-time procedure, In [18], If the UE has to receive the switching notification response message before the switching, the activity on network B may be delayed. Thus, the reception of the switching response message could be optional. There could be several options:

* **Option 1: Perform switching only after the reception of the Switching Response Message**. The network acknowledges the switching notification message via the switching response message. And UE switches after receiving the switching response message.
* **Option 2: Perform switching without Switching Response Message**. UE requests for the switching and is allowed to perform autonomous switching without the reception of Response Message.
* **Option3: Others**, if any, please comment.

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

1. **Whether should UE wait for the Response Message for one-shot short-time switching?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option1/2/3** | **Comments** |
| Ericsson | 3 | If there would be a need for the UE to have a specific handling for one-shot short-time switching, then option 1 would be needed. But as said for Q10, there is no need for a specific handling of one-shot short time switching. The UE can leave for one short-time switching during the periodic interruptions that the network may have configured. |
| Sharp | 3 | Agree with Ericsson. |
| Oppo | 2 | Unlike long-time switching, the consequence caused by short-time switching is not so big even performing switching without Switching Response Message |
| CATT | 2 | Whether perform the switching in case Switching Response Message is not received in a certain period could be up to UE implementation. |
| vivo | 3 | First, considering some one-shot short-time activities are flexible to perform (i.e. can allow some delay before being initiated), UE may wait for the response message, which is beneficial to keep UE behavior consistent with network A.  However, anyway this should not require the UE to perform switching only after receiving the response, since that network A may decide not to give any response to the UE, at all.  UE may wait in network A for Response Message within a certain time, similar to the long-time switching procedure. |
| Apple | 3 | Choice of Option 1 or Option 2 would depend upon the maximum delay incurred in waiting for the switching response message. In the worst case, we can have a timer based mechanism which determines when the UE can autonomously switch without waiting for the switching response message. |
| Samsung | 1 | If gap pattern for one-shot short-time switching can be requested as it does for periodic short-time switching, it should be up to a network decision whether a UE is allowed to temporarily switch to other network i.e. within the configured/confirmed one-shop gap from the current network. Thus, we do not see any need to have different solutions for periodic and one-shot short-time switching procedures.  Of course, it can be up to UE implementation whether to temporarily switch to other network for one-shot short-time switching activity within the configured periodic gap. |
| LG | 3 | Agree with Ericsson |
| ASUSTeK | 3 | We agree with Ericsson’s comment. |
| Fraunhofer | 1 | Agree with Samsung |
| Huawei, HiSilicon | 3 | We slightly prefer to leave this to UE implementation to use the available gap in NW A to perform measurement for cell reselection or SI acquisition in NW B.  If the majority think such procedure is necessary for the one-shot switching, we are fine for Option 2. The same logic can be applied that it is better to leave NW A and performs the activities in NW B as soon as possible. |
| MediaTek | 3 | Agree with Ericsson. |
| ZTE | Option 1 | For this question, we prefer option 1, for that the network A is still at the connected state, the UE need clear response from the network. |
| Xiaomi | 3 | Agree with Ericsson. |
| SONY | 3 | A Switching Respons is preferred but not necessary. Could be used together with a (short) timer before leaving similar as proposed for long time switching. |
| Convida | 2 |  |
| Charter Communications | 3 | As in response to Q10, there is no need for specific procedure for one-shot switching. Agree with Ericsson. |
| NEC | 3 | This can be up to UE implementation, i.e. UE can do it autonomously if the UE is fine to drop potential data/signaling in network A within a short time. |

**Summary:**

TBD.

As captured in RAN2 agreements, there may be different mechanisms (short/long, leaving/returning, etc.). A Return message could be required in one-shot short-time switching in the following cases.

* It is hard to decide the exact length for one-shot short-time switching in many cases. If the gap length allocated is longer than required, UE will prematurely return to network A before the gap expires, in such case a UE return message to notify network A may be useful.
* If a gap length is not provided(e.g. UE switches without the reception of switching response), a return message is required for UE to notify the network.

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

1. **Whether a Return message is needed for one-shot short-time switching?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Ericsson | No | Similar comments as Q11. If we are using the periodic short time switching defined, there will be no need for a return message. |
| Oppo | Yes | For one-shot short-time switching case, UE is still in connected mode in network A. It’s benefitial to achieve timing synchronization between UE and network A if UE returns from resources efficiency perspective, so it’s a good way to have Return message. |
| CATT | No | It will work well without a return message.We can keep the solution as much as simple. |
| vivo | Yes | A return message is needed for the below two cases:  1. UE returns before the configured gap length expires; UE may send a return message to network A, e.g. to resume the DL data transfer.  2. If UE is permitted to switch without the reception of response message, the gap length may not be configured to the UE. In this case, UE needs to send a return message when it returns back to network A. |
| Apple | No | This would depend upon the outcome of Q11. If there is no response message being waited for, then the need for Return message does not arise. Also, we need to ensure that the overhead of this short switching is not more than that the short switching duration itself. |
| Samsung | No | We think it is a minor optimization issue. |
| LG | No | We think a common procedure is enough to perform short time switching. The UE can request to update the scheduling gaps to the network whenever the gap information needs to be newly required. |
| ASUSTeK | No | A common procedure could be used for both one shot/periodic short-time switching. |
| Fraunhofer | Maybe | Depends on the design of the one-shot switching procedure |
| Huawei, HiSilicon | No | Even the one-shot switching procedure is defined, we think the return message is not needed. When the UE does not need the gap, the UE send the indicate the release of the gap to the NW. |
| MediaTek | No |  |
| ZTE | Maybe | No strong opinion |
| Xiaomi | No |  |
| SONY | No | Try to keep the procedure simple |
| Convida | No |  |
| Charter Communications | No | As in response to Q10/11, there is no need for specific procedure for one-shot switching. |
| NEC | No | No very strong need for this. |

**Summary:**

TBD.

Companies are invited to express their view if any other comments or suggestions.

1. **Any other comments or suggestions on the solution for one-shot short-time switching?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | See the comments in the Question 10 |
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**Summary:**

TBD.

## Busy Indication

In RAN2#112e, the following busy indication related agreements were made.

* From RAN2 point of view, it is feasible that the busy indication is sent as an RRC message with security for RRC\_INACTIVE. FFS how this works.

**=> FFS if/how to ensure UE doesn't disconnect from RRC\_CONNECTED during busy indication**

We will discuss the above open issues in this section.

## **How to send the RRC busy indication in RRC\_INACTIVE**

For RRC inactive UE, [5,19] mentioned that the UE can include the busy indication in the RRC connection resume request message. The network can confirm the busy indication via RRCRelease.



**Figure 4 Busy Indication in RRC\_INACTIVE**

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

1. **Do companies agree with the general RRC procedure of sending Busy Indication in RRC\_INACTIVE state, i.e. UE sends busy indication in the RRC connection resume request message, and the network confirms the busy indication via RRCRelease?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Ericsson | No, but | Even though we can say it is feasible to include it in the RRC Resume Request message, it should be noted that there are few spare values that are too costly to use for the sake of busy indication. An alternative approach would be to include the busy indication into the RRC Resume Complete message. |
| Sharp | Yes |  |
| Oppo | Agree if the security issue is resolved | Busy indication in the RRC connection resume request message has no integrity protection and ciphering, so this info may be changed by a third party, it’s better to enhance step 2 in figure 4 to let UE double check the integrity of busy indication. |
| CATT | Yes, but | The mentioned procedure is feasible. But we think a unified solution(RRC based or NAS based) for both RRC\_INACTIVE and RRC\_IDLE would be better. |
| vivo | Yes | Agree with the general RRC procedure of sending Busy Indication in RRC\_INACTIVE state. There are five spare codepoints for *ResumeCause* and one can be used for busy indication. Upon the reception of *RRCResumeReq* with *ResumeCause* “busyindication”, the network B can respond to the busy indication via *RRCRelease*. In this way, the shortest time required for UE to send a busy indication can be achieved. |
| Apple | Agree if security aspects are resolved | Same comment as Oppo. Also in favor of an unified solution for RRC\_IDLE and RRC\_INACTIVE as CATT had indicated. |
| Samsung | May be | It would be good to first discuss whether busy indication itself is needed or not as it might be merely used by network to verify whether UE receives paging message correctly. In order to send busy indication in response to paging, the UE needs to suspend on-going data transmission in current network. Even though the UE just ignores the paging, the UE may respond to it later as repetitive paging transmission is allowed from network.  If busy indication is agreed to be supported, then we agree with Figure 4 i.e. new resume cause value for busy indication in resume request message can be defined. We have some sympathy that new cause value may be costly, but negative impact on ongoing service in current network could be minimized with new cause value without entering RRC\_CONNECTED. |
| LG | Yes | It is feasible to send a busy indication when sending RRC Resume Request message. But if there is a size issue, RRC Resume Complete message is also a feasible way to send a busy indication w/o RRC Connection. |
| ASUSTeK | Yes | We agree with Samsung’s comment. |
| Fraunhofer | Maybe | Agree with Samsung |
| Huawei, HiSilicon | May be | We also prefer a unified solution. Considering that the NAS based solution will be defined by SA2, we can use it also for RRC Inactive state. |
| MediaTek | Yes, but | We agree that the need of busy indication may need to be confirmed first. If busy indication is to be introduced, RRC busy indication as shown here should be supported. As mentioned by vivo, using one spare value in *ResumeCause* is acceptable to us. |
| ZTE | Yes | We agree with this general procedure |
| Xiaomi | No, but | We should consider the size of the busy indication and include the busy indication into the RRC Resume Complete message instead. |
| SONY | Yes, but | The procedure for RRC\_INACTIVE state is feasible, but agree with Ericsson that there are alternative solutions to be studied. |
| Convida | Yes |  |
| Charter Communications | Yes, but | Yes, but we should first discuss the cases where sending busy indication has value. E.g. if the UE is engaged in a Mobility Management procedure on network A, and receives a page on network B (which corresponds to ‘short-term switching’ per our suggested interpretation in Q1), then network B could benefit from receiving busy indication. |
| NEC | Not sure | We agree to have RAN-based busy indication (instead of NAS-based), such that the gNB can be aware of it and release the UE directly. We are ok if there is no security issue if the RAN-based busy indication is carried in RRCResumeRquest, as the agreement in RAN2#112e (i.e. from RAN2 point of view, it is feasible to send busy indication as an RRC message with security for RRC\_INACTIVE) was not very clear in which message the busy indication can be sent. If there is security issue, same as Ericson, it can be carried in RRCResumeComplete. |

**Summary:**

TBD.

## **If/How to ensure UE does** **n**o**t disconnect in network A**

When the UE has an ongoing service in network A, a busy indication is triggered that towards to network B if the UE decides not to respond to paging in network B. Hence, UE sends busy indication to network B which implies it wants to keep the connection/ongoing service in network A. With this in mind, the rapporteur thinks it should be ensured that UE does not disconnect in network A while sending busy indication in network B.

What’s more, SA2 has achieved the below conclusions for busy indication.

|  |
| --- |
| - If Multi-USIM device received paging by Network-A in RRC\_Idle mode and the device decides to accept the paging, UE shall perform as existing procedure (send the Service Request message).  - If Multi-USIM device received paging by Network-A in RRC\_Idle mode and the device decides not to accept the paging, a UE supporting NAS BUSY indication attempts to send a BUSY Indication via NAS message to network unless it is unable to do so e.g. due to UE implementation constraints.   NOTE X1: Whether Busy indication is supported for RRC\_Inactive case is up to RAN decision. |

According to the discussion in SA2, the UE implementation constraints rely on the connectivity and services in another network, e.g. SA2 assumes for some services, keeping the service ongoing without impacts in network A and sending NAS busy indication to network B cannot be performed simultaneously(e.g. sending busy indication may cause the QoS of the ongoing service cannot be ensured), the busy indication sending can be omitted in these cases. Similar principle may be consided in RAN2.

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

1. **Do companies agree to ensure UE keeps RRC\_CONNECTED in network A during sending busy indication in network B?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Ericsson | No, but | Similar as what we said for 2.3.2, busy indication would be a one time indication that one could do within the time of other interruptions already configured by the network. |
| Oppo | Maybe | At least in the negotiated gap duration, the connected state in network A can be guaranteed; otherwise, more like a network A implementation. |
| CATT | Yes, but | We agree with rapporteur that “UE sends busy indication to network B which implies it wants to keep the connection/ongoing service in network A.” But whether the connected state could be kept is network A implementation. |
| vivo | Yes | Agree with the comment from CATT.  We think a smart network implemation should avoid to release UE during the UE sending busy indication in another network and the UE should not initiate a long-time switching in NW A for the sending of busy indication in NW B. |
| Apple | Yes | Since the reason as to why the UE is sending busy indication in network B is to continue with its ongoing activity in network A (and connected state thereof). |
| Samsung | Yes | We do not see any need for network A to move UE to RRC\_IDLE/RRC\_INACTIVE from RRC\_CONNECTED during sending busy indication in network B. |
| LG | Yes | If a scheduling gap is used, it is possible that the UE keeps RRC\_CONNECTED on network A while sending a busy indication to network B. This is because we think a scheduling gap can be a common procedure not only for one-shot switching but for periodic switching. |
| ASUSTeK | Yes | We agree with CATT’s comment. |
| Fraunhofer | Yes |  |
| Huawei, HiSilicon | No | UE can't predict the gap length that is used to send the busy indication, especially for the NAS-based busy indication which may be over a hundred milliseconds. So we think the procedure defined in 2.3.2 is not suitable. Instead, the procedure defined in 2.2 should be used to in order to send the busy indication.  In addition, it should be NW’s decision whether to keep the UE in RRC connected duing sending busy indication. |
|  | Yes, but | We agree that UE should be kept RRC\_CONNECTED in Network A when sending busy indication, but this should be controlled by network. |
| ZTE | Yes | To avoid the bad impact on the UE’s experience, it’s better to keep RRC\_Connected state in network A. |
| Xiaomi | Yes |  |
| SONY | Yes | It is preferred that the UE is kept in connected mode during the gap when the busy indication is sent and in the case of a NAS based busy indication, a response is received, in order for the UE to continue the data connection on the current NW |
| Convida | Maybe | Share same view as Oppo |
| Charter Communications | Yes | There are use cases where the UE being in connected state should not be interrupted while sending a busy signal in network B. |
| NEC | Yes, but | Agree with CATT. |

**Summary:**

TBD.

As shown in Figure 4, the procedure for paging reception and busy indication sending includes a periodic short-time activity(paging reception) and a one-shot short-time activity (busy indication sending). And, these two activities are normally continuously performed by UE.

Based on the above discussion for periodic/one-shot short-time switching, there could be several options to support paging reception and sending busy indication.

* **Option 1: One-step switching with long gap,** i.e. the gap allocated for the switching is long enough for UE to perform both paging reception and busy indication sending. UE sends busy indication during the gap when necessary.
* **Option2: Two-step switching,** i.e. a first gap allocated for the first switching is only enough for UE to perform paging reception. If the UE decides to send busy indication after paging reception in network B, it goes back to network A and asks for a second switching for busy indication sending.
* **Option3**: **Others,** if any, please comment.

Note: Solutions that allow the UE to send busy indication by extending the gap without informing the network A are not listed here. These solutions may result in network A releasing the UE while the UE doesn’t come back as expected.

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

1. **Which option is suitable for sending busy indication?**

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| --- | --- | --- |
| **Company** | **Option 1/2/3** | **Comments** |
| Ericsson | 3 (up to UE implementation) | In a first periodic interruption the UE can perform paging reception, while in a second periodic interruption the UE may send the busy indication. If the NW configures a periodic interruption for the UE that is long enough, the UE may also be able to perform both activities within a single interruption (option 1 above), but it depends on how large those interruptions would be – there is no need to define a strict handling as option 1 and 2, it can be left up to UE implementation. |
| Oppo | 3 (up to UE implementation) | The same view with Ericsson |
| CATT | 3 (up to UE implementation) | Agree with Ericsson. |
| vivo | 3 (up to UE implementation) | Whether and how UE sends busy indication is up to gap pattern. If the configured gap length is long enough to complete sending the busy indication, UE can send busy indication within the configured gap (option 1).  As per SA2 conclusion, sending the busy indication can be omitted due to UE implementation constraints. Therefore, UE may send the busy indication as best effort action. If the assigned gap is not long enough to complete sending the busy indication, sending the busy indication can be omitted. |
| Apple | 3 | This is a function of how long the initial switching gap is configured as. If the gap is long enough in the first place, then both paing decode and sending of busy indication can be done together. |
| Samsung | 3 (up to UE implementation) | We think it is not preknown to UE whether busy indication is also to be sent and/or periodic gap can accomodate busy indication always. It seems better to leave it to UE implemention to perform this in either in 1-step when feasible or 2-steps when needed. |
| LG |  | We don’t think only one option should be chosen. If the UE can send the busy indication within the gap period, then there is no need to consider a two-step switching procedure. Otherwise, i.e. additional gap period is required in the UE perspective, the UE may ask for additional gap configuration to the network for sending the busy indication for the next gap duration. |
| ASUSTeK | 3 | It can be left up to UE implementation. |
| Fraunhofer | 3 | Upto implementation. A UE can make a fair judgement of the required time to perform the two procedures in tandem. Though it would be efficient to have only one gap, this should be left to implementation. |
| Huawei, HiSilicon | 3 (up to UE implementation) |  |
| MediaTek | 3 (up to UE implementation) | Agree with vivo. |
| ZTE | 2/3 | For the option 1, the UE only response the paging that included the matched paging ID, thus the paging response is an aperiodic event, while the paging detection is a periodic event. Thus option 1 is not suitable, which will cause unnecessary long gap assignment  For the option 2, it seems ok, but we think that the RAN paging were triggered once data arrived for a PDU session, even the busy indication was send, there are still 2 problems:   1. The data will stored temporally at the gNB, then when the gNB can resume the paging for this PDU? 2. If there were data arrived on other PDUs, whether the gNB trigger the RAN paging again? |
| Xiaomi | 3 (up to UE implementation) | Agree with Ericsson. |
| SONY | 2 | When the NAS based busy indication is sent the UE needs to wait for a respons of the busy indication. That will not fit into the measurement gaps. Then it is better to design a gap for this busy indication when needed. This long gaps would be a waste of time if busy indication is not sent. |
| Convida | 3(up to UE implementation) | Same view as Ericsson |
| Charter Communications | 3 (up to UE implementation) | Pending the duration required for sending busy indication, the UE may end up doing it in one-step or in two steps using two gaps of short-time switching, as described by Ericsson. |
| NEC | 3 (up to UE implementation) | Agree with Ericsson. |

**Summary:**

TBD.

## Other Comments

Companies are invited to express their view if any other overall comments or suggestions on the solutions of network switching.

1. **Any other comments or suggestions on the solutions of network switching?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | As comment in the Q16, we think that the RAN paging were triggered once data arrived for a PDU session, even the busy indication was send, there are still 2 problems:   1. The data will stored temporally at the gNB, then when the gNB can resume the paging for this PDU?   (2)If there were data arrived on other PDUs, whether the gNB trigger the RAN paging again? |
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**Summary:**

TBD

# Conclusions

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

**TBD**

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