**3GPP TSG RAN WG2 Meeting #121-bise**    **R2-230xxxx**

Electronic, 18th– 26th Apr, 2023

Agenda Item: 8.1.1

Source: ZTE Corporation (Rapporteur)

Title: Summary of [Post121][703][NCR] RRC running CR for NCR (ZTE)

Document for: Discussion and Decision

# Introduction

This is the summary of post email discussion:

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| * [Post121][703][NCR] RRC running CR for NCR (ZTE)   Scope:   * Updates based on the agreements during RAN2#121 * Can discuss open issues.   Intended outcome: revised running CR, discussion paper with proposals (if needed)  Deadline: Long |

In this document, we focus on the remaining open issues for RRC spec. The TS 38.331 running CR which captures RAN1/2 agreements is discussed via separate document.

The outcome of this discussion will be captured into RRC running CR after the proposals are agreed in RAN2#121bis-e.

Please companies provide your inputs before 31th Mar.

Rapporteur will provide summary with proposals before 5th April.

# Contact information

Companies providing input to this email discussion are invited to leave contact information below.

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# Discussion

## Select back to suitable cell

During RAN2#121 meeting, companies discussed the NCR-MT’s behaviour when cell reselection occurs and made the following agreement:

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| * After cell reselection, the NCR-MT to resume so that it can receive side-control configuration from the new gNB (can be done by network configuration using existing specifications). The case when a NCR-MT selects/reselects to an acceptable cell or when no cell is found and comes back is FFS. |

Companies think the NCR-MT behaviour is unclear when the NCR-MT moves back to suitable cell if it was camping on acceptable cell or if no cell was found.

For this issue, rapporteur has observed the following in CN specs:

Firstly, when a UE (NCR-MT) camps on acceptable cell or if no cell can be found, according to TS 23.122, the UE (NCR-MT) shall enter “limited service state”.

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| *# TS 23.133 section 3.5*  3.5 No suitable cell (limited service state)  There are a number of situations in which the MS is unable to obtain normal service from a PLMN or SNPN. These include:  a) Failure to find a suitable cell of the selected PLMN or of the selected SNPN; |

Then in TS 24.501, there are two specified UE 5GMM sub-states for limited service state:

* Case 1: 5GMM-REGISTERED.LIMITED-SERVICE
* Case 2: 5GMM-DEREGISTERED.LIMITED-SERVICE

For Case 1, according to TS 24.501, after the UE (NCR-MT) reselects to a suitable cell, the UE shall initiate NAS registration procedure.

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| *# TS 24.501 section 5.2.2.3.2*  5.2.2.3 Detailed description of UE behaviour in state 5GMM-DEREGISTERED  5.2.2.3.2 LIMITED-SERVICE  The UE shall initiate an initial registration procedure when entering a cell which provides normal service.  The UE may initiate initial registration for emergency services. |

For Case 2, the UE (NCR-MT) behaviour is defined as below, as we can see that, after registration, the UE will be configured with a timer T3512. When the timer expires, although the UE cannot trigger periodic registration update procedure immediately, the UE is expected to re-initiate NAS registration procedure when the it finds a suitable cell which can provide normal service.

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| *# TS 24.501 section 5.2.3.2.4*  5.2.3.2 Detailed description of UE behaviour in state 5GMM-REGISTERED  5.2.3.2.4 LIMITED-SERVICE  The UE:  a) shall perform cell selection/reselection;  b) may perform de-registration locally and initiate an initial registration for emergency services; and  c) if configured for eCall only mode as specified in 3GPP TS 31.102 [22], shall perform the eCall inactivity procedure at expiry of timer T3444 or timer T3445 (see subclause 5.5.3).  *# TS 24.501 section 5.3.7*  5.3.7 Handling of the periodic registration update timer and mobile reachable timer  The periodic registration update procedure is used over 3GPP access to periodically notify the availability of the UE to the network. The procedure is controlled in the UE by the periodic registration update timer, T3512.  …  If the UE is registered for emergency services, and timer T3512 expires, the UE shall not initiate a periodic registration update procedure, but shall locally de-register from the network. When the UE is camping on a suitable cell, it may re-register to regain normal service. |

Based on above analysis, rapporteur thinks the current specification already defines NAS procedure for the case when UE reselecting back to suitable cell, the NCR-MT won’t become unreachable.

**Rapp’s observation: When NCR-MT camps on acceptable cell or when no cell is found, the NCR-MT shall enter limited service state. After the NCR-MT selects a suitable cell, its NAS layer will initiate registration procedure and NCR-MT will initiate RRC connection procedure. No need to specify new mechanism for this scenario.**

**Q1. Do companies agree with above Rapp’s observation? please elaborate your comments if answers “No”.**

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| **Company** | **Yes/No** | **Comments** |
| Ericsson | Yes | We have the same understanding as the Rapporteur. Current specification already handle the case that is FFS and there is no need of a new mechanism specific for NCR. |
| CATT | Yes | Share the same view as Rapp. The limited service state in CN spec can handle the concerned issue already, there is no any further optimization is needed right now. |
| Samsung | Comment | The definition of an acceptable cell is the following in 38.304:  ***acceptable cell:***  *An "acceptable cell" is a cell on which the UE may camp to obtain limited service (originate emergency calls and receive ETWS and CMAS notifications). Such a cell shall fulfil the following requirements, which is the minimum set of requirements to initiate an emergency call and to receive ETWS and CMAS notification in an NR network:*  *- The cell is not barred, see clause 5.3.1;*  *- The cell selection criteria are fulfilled, see clause 5.2.3.2.*  For NCR-MT, none of these can be applicable as the NCR cannot make calls and there is no action to perform if emergency notification is signaled.  Thus we believe that an NCR cannot camp on an Acceptable cell.  Furthermore, in RAN2#121 we made the following agreement:   * *The NCR-FWD is switched OFF if the NCR-MT in RRC\_INACTIVE state reselects a different cell than the last serving cell on which side control configuration was received.*   To make this complete, we believe that we can make it clear that if no suitable cell is found, the NCR-Fwd is turned OFF. The agreements from this can be:  **Proposal 1: If NCR-MT in RRC idle or inactive detects no suitable cell, the NCR-MT recovers using legacy NAS recovery mechanisms. NCR-MT does not camp on an Acceptable cell.**  **Proposal 2: The NCR-Fwd is switched OFF if the NCR-MT in RRC\_INACTIVE detects no suitable cell.** |
| Nokia | Yes | Regarding Samsung’s comment, we agree that emergency calls/alerts do not seem very applicable to NCR-MT; however, we think the term *“limited service”* in the *acceptable cell* definition from 38.304 is perhaps ambiguous or not being used consistently with the term *“limited service”* from the CN specifications. The procedures provided from 24.501 above only state that the UE *may* initiate registration for emergency services. Hence, based on the procedures in 24.501, we think the NCR-MT would be able to camp on an acceptable without issue: i.e., *if the NCR-MT is 5GMM-REGISTERED, it shall perform cell selection/reselection*; and *if the NCR-MT is 5GMM-DEREGISTERED, it shall initiate an initial registration procedure when entering a cell which provides normal service*. Registration for emergency services is optional.  There is probably no need to specify that the NCR-Fwd is OFF in the case where it camps on an acceptable cell, since this would only happen if no suitable cell is found during 1) cell reselection, 2) integration/startup (i.e. before acquiring SCI), or 3) RLF. In all of those cases NCR-Fwd would already be OFF. |
| Apple | Yes | First, we believe camping on an acceptable cell does not allow NCR-Fwd to operate. The existing RAN2 agreements are clear on this aspect.  Then, according to the current spec, the NCR-MT will enter limited service state and only emergency service is allowed. Since NCR-MT will not initiate emergency session, we think it is fine to leave it as it is and nothing more needs to be said. |
| Qualcomm | Yes | The NCR-MT uses legacy NAS recovery mechanisms. Agree with Samsung that the NCR-FWD is switched off if the NCR-MT detects no suitable cell. |

## Wake-up timer

In RAN2#121, RAN2 agree that the gNB shall be able to release NCR-MT to RRC\_IDLE state, companies also discussed the solution for triggering the NCR-MT back to RRC\_CONNECTED mode, e.g. wake-up timer. If wake-up timer is configured to NCR-MT, the NCR-MT should start the timer when it enters RRC\_IDLE state, and the NCR-MT shall initiate RRC connection setup procedure when the timer expires.

Based on the online discussion in RAN2#121 meeting, company views are divergent and no conclusion was made. During online discussion, some companies also pointed out that this can be done via OAM, if necessary.

Technically, if wake-up timer is not introduced in RRCRelease, then after the NCR-MT is released to RRC\_IDLE, it is up to the NCR-MT to initiate RRC connection procedure, this can be done via NCR-MT’s OAM, or the gNB can provide “wake-up” timer to NCR-MT via OAM connection (if established).

In RAN2, we need to focus on our specification impact, so the question is whether to introduce explicit “wake-up timer” field in RRCRelease message, and there are two options on the table:

* Option 1: To define “wake-up timer” IE in RRCRelease message;
* Option 2: Do not define “wake-up timer” IE in RRCRelease message, if needed, it can be done via OAM (no specification impact).

**Q2. For NCR-MT in RRC\_IDLE state, which option do you prefer regarding the wake-up timer?**

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| **Company** | **Option 1/2** | **Comments** |
| Ericsson | Option 1 | The network may want to have different value for the wake up timer based on the situation on when the NCR is sent to IDLE. The solution where OAM provide the wake timer does not provide any flexibility as the OAM signaling is rather static then dynamic.  Also, we already agreed that the support of DRBs for an NCR is option and thus without support for DRB there is no OAM. We believe this will limit possible implementation of NCR.  Option 1 provide better flexibility for the network but also for the operator that may bring back to CONNECTED the NCR-MT based on the different use case in which an NCR node is used. |
| CATT | Option 2 | Considering OAM can solve this issue, hence no need to introduce additional specification work considering the limited time left. |
| Samsung | Option 1 | Defining a Wakeup timer in RRC release allows for greater flexibility.  We think using a timer similar to T380 can be used, T4XX can be a suitable name. It starts upon reception of the timer in RRCRelease and at expiry the actions of Section 5.3.3 are performed.  Timer values can be similar to or more coarse as that compared to T380: {min10, min20, min30, min60, min120, min240, min480, min960}  Handling it via OAM has a number of problems:  1) gNB is no longer in control of the timer duration, which may need to change according to its own conditions/implementation.  2) gNB may not know when the wakeup timer has been configured or re-configured before releasing an NCR-MT to RRC idle. This means that some proprietary solution is need to ensure that a gNB knows when it has been configured is needed. |
| Nokia | Option 2 | In general, we do not see why it is essential to specify a flexible/dynamic wake-up timer. If flexibility is needed, wouldn’t releasing the NCR-MT to RRC\_INACTIVE state be preferable? Besides, timer granularity may not be a trivial issue to decide: if the timer is too short, more signalling overhead will be introduced and the benefit of sending the NCR to a low power state will be lost, while if the timer is too long the gNB cannot change the NCR-Fwd configuration very adaptively. This is where RRC\_INACTIVE seems like a better option.  We think it is okay to leave how the NCR-MT wakes up from RRC\_IDLE to implementation/OAM. We disagree that lack of DRB means no OAM. We recall that some companies had previously stated that OAM could be accessed by other technologies, e.g. wired connection, which is why they did not support mandating DRB. |
| Apple | Option 2 preferred | Since the configuration of wake-up timer can be done anyway via OAM means, then there is no strong justificaiton to change RRC spec for this. |
| Qualcomm | Option 2 |  |

## ON/OFF in RRC\_IDLE

For NCR-MT in RRC\_INACTIVE state, RAN2 made the following agreement in RAN2#120:

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| RAN2#120 agreement:   * After NCR-MT enters RRC\_INACTIVE mode, the NCR-Fwd can be ON or OFF following the last configuration received from the gNB. |

Since releasing to RRC\_IDLE mode is supported, RAN2 need to discuss the NCR-Fwd ON/OFF behaviour when NCR-MT is released to RRC\_IDLE mode.

Based on company contributions, there are two options:

* Option 1: NCR-Fwd is OFF when NCR-MT is in RRC\_IDLE state;
* Option 2: When NCR-MT is released to RRC\_IDLE mode, the NCR-Fwd can be ON or OFF following the last configuration received from the gNB.

Option 1 is straightforward, but it disallows the network to enable NCR-Fwd when releasing the NCR-MT to RRC\_IDLE; Option 2 is aligned with principle agreed for RRC\_INACTIVE state and no additional specification effort is needed. Companies are welcome to provide your preference.

**Q3. Which option do you prefer when releasing the NCR-MT to RRC\_IDLE state?**

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| **Company** | **Option 1/2** | **Comments** |
| Ericsson | Option 2 | We prefer to align with the RRC\_INACTIVE case. We don’t see the benefit of having two different behaviors for IDLE and INACTIVE. |
| CATT | Option 1 | In RAN2#120 meeting, the below agreement was reached:   * If NCR-MT enters RRC\_IDLE due to no suitable cell is find, NCR-Fwd is OFF;   If option2 is chosen, just wonder whether we need to revisit the agreed agreement already? |
| Samsung | 2 | As we mentioned in RAN2#121, we believe that Option 2 allows for greater network flexibility. This is important as RRC inactive is a feature that is both optional from network and NCR point of view. If for instance a network operator does not utilize RRC inactive due to various reasons, this means that the most typical operation of an NCR is not available and an NCR-MT needs to be kept in RRC connected mode. This is not only wasteful of network resources, but is also not entirely cost-free as it is very unusual for a network to keep a device in connected mode for a long time without any DL/UL – in other words this also requires implementation efforts. We want to keep NCR simple both for implementing the actual NCR device but also for the network to implement NCR.  What CATT mentions above has entirely been taken out of context as that is for the purpose of RRC re-establishment. |
| Nokia | Option 1 | We do not see why NCR-Fwd behaviour during RRC\_IDLE should be aligned with RRC\_INACTIVE. As we commented above, we think RRC\_INACTIVE can be used for a reduced-power state while still operating the NCR-Fwd and provides the flexibility that is needed vs a wake-up timer. Considering that NCR is a network device, RRC\_IDLE seems more applicable to the case where an operator would want to intentionally shut off the NCR-Fwd for a prolonged period with the intention of not providing coverage to users.  We somewhat sympathize with Samsung regarding RRC\_INACTIVE. However, we are not really sure there would be much additional network resource consumption if the NCR-MT is kept in RRC\_CONNECTED. IAB has the same issue if there are no users. |
| Apple | Option 2 | Our understanding is that the IDLE and INACTIVE cases can be handled similarly, if the “unable to trigger CN paging” issue can be solved satisfactorily according to Q2. But if we really have no consensus on Q2, then to make progress, we can also accept Option 1 if Option 1 is the majority view. |
| Qualcomm | Option 1 | RRC IDLE should not be used as a FWD operation state, in particular, because the gNB has no option to pull it out of RRC IDLE in case it wants to reconfigure the NCR. For this purpose, RRC INACTIVE can be used. |

## Clafication on the “last configuration”

For NCR-MT in RRC\_INACTIVE state, RAN2 agree that the NCR-Fwd can be ON-OFF following the last configuration received from the gNB. However, it is not crystal clear what the “last configuration” means.

Based on RAN1 conclusions, 3 types of beam indication are supported for NCR-Fwd access link:

* Type 1: Periodic beam indication. Configured by RRC signalling.
* Type 2: Aperiodic beam indication. Configuration provided via RRC signalling and the network uses DCI to activate/deactivate.
* Type 3: Semi-persistent beam indication. Configuration provided via RRC signalling and the network uses MAC CE to activate/deactivate.

Based on company contributions, some company suggests to clarify that only periodic beam indication configuration is feasible for NCR-Fwd when NCR-MT enters RRC\_INACTIVE state. Because the NCR-MT cannot receive DCI/MAC CE in RRC\_INACTIVE state.

Considering periodic beam indication can be configured by RRC signalling only, then a straightforward solution is to rely on the RRC configuration. Please see rapporteur’s proposal below:

**Rapp’s Proposal When releasing the NCR-MT to RRC\_INACTIVE state, only periodic beam indication configuration is applicable to the NCR-MT (i.e. *ncr-PeriodicFwdResourceSetToAddModList-r18* IE included in RRCReconfiguration sent before RRCRelease). The NCR-Fwd is OFF if periodic beam indication is not configured.**

**(Note: This proposal also applies to NCR-MT in RRC\_IDLE mode if Option 2 in 3.3 is agreed)**

Companies are welcome to provide your views regarding the “last configuration”.

**Q4.1. Do you agree with above Rapp’s proposal? please elaborate your comments if answers “No”.**

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| **Company** | **Yes/ No** | **Comments** |
| Ericsson | Yes with comments | We agree in principle with the Rapporteur, but we are wondering on whether it would be enough to clarify that the “last configuration” is that one provided by RRC. However, no strong view. |
| CATT | Yes | Share the same view as Rapp. |
| Samsung | Yes | In principle we think that it would have been fine to include both Type 1 and 2, but for release 18 this could be sufficient. |
| Nokia | Yes |  |
| Apple | Yes |  |
| Qualcomm | No | Type 1 should be supported as indicated by the rapporteur.  Type 2 should not be supported since it is aperiodic and will expire shortly.  Type 3 is very similar to Type 1 and should be supported (*reception of MAC CE would still occur while NCR-MT is in RRC CONNECTED state*). Additionally, Type 3 gives control to the gNB-DU to decide which of the side control configurations for the NCR shall be activated. when the MT is sent to INACTIVE. |

In addition, another question is whether/when the NCR-MT should discard the beam indication configuration? As agreed in RAN2#120, the NCR-Fwd is OFF when NCR-MT reselects to a different cell. However, this does not mean the corresponding configuration is discarded at the same time.

Based on the online discussion in RAN2#121, in order to extend cell coverage, the NCR device may be deployed at cell edge, so Ping Pong cell reselection may happen if DL signal fluctuates. If the NCR-MT can store the received beam indication configuration, then it can be used whenever the NCR-MT camps on the releasing cell. However, if the NCR-MT moves to a different cell and triggers RRC resume procedure, it is better to discard the configuration and wait for new configuration from the network.

**Rapp’s Proposal The NCR-MT shall discard the received beam indication configuration (i.e. *NCR-FwdConfig-r18*) when it initiates RRCResume procedure in a cell different from the released cell.**

**Q4.2. Do you agree with above Rapp’s proposal? please elaborate your comments if answers “No”.**

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| **Company** | **Yes/ No** | **Comments** |
| Ericsson | Yes | We agree with the Rapporteur. We think there is no issue for the network to provide a new configuration when the UE resumes. Is not clear what is really the benefit is the NCR stores it. |
| CATT | Yes | Share the same view as Rapp. |
| Samsung | Neutral | On one hand, we think that maybe there is no need to specify when the beam indication configuration is discarded. On the other hand it could be useful to be explicit. Actually in some cases the beam indication configuration could potentially be the same regardless of the cell the NCR-MT is connected to, due to the NCR being stationary and serving the same area, but this would be an optimization. |
| Nokia | Yes |  |
| Apple | No | We do not follow the logic of this proposal. If we do not consider ping-pong effect, then the “last configuration” will be discarded immediately after NCR reselects a different cell. If we do care about ping-pong, then the configuration will be kept until it has been override by gNB in a new RRCReconfiguration or RRCResume. Either way, we do not see why NCR has to be mandated to only release the ”last configuration” when sending RRCResumeRequest. It is very possible that the RRC Resume procedure may fail. If we follow the proposal and the RRC resuem procedure fails, then we create a singular state where NCR-MT is still vulnerable to “Ping-pong” but having no “last configuration” at all. |
| Qualcomm | Yes | Agree with rapporteur. |

## Other

Besides above questions, companies are welcome to provide your comments if other issues are identified. Please notice the WID is extended 1 quarter in RAN2, so please focus on **essential** issues.

**Q5. Any other RRC open issues that need to be discussed in RAN2?**

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| **Company** | **Comments** |
| Ericsson | From the RRC and MAC parameters list there are still a lot of FFS. Not sure if RAN1 will have discussions on NCR in the next meeting but if this is not the case we should definitively send them an LS. |
| Samsung | In RAN2#120 we made the following agreement:  *On NCR-MT RLF:*   * *After RLF is declared by NCR-MT, NCR-MT performs cell selection and trigger RRC re-establishment;* * *If NCR-MT enters RRC\_IDLE due to no suitable cell is find, NCR-Fwd is OFF;* * *During RRC re-establishment procedure, NCR-Fwd is OFF.*   In the CR we only have text on turning OFF NCR-Fwd if the NCR-MT starts the action of performing RRC re-establishment. Similar to BFR operation as agreed in RAN1 (as is also captured in the MAC spec), we need to add turning on NCR-Fwd after successfully re-establishing. This can probably be done when NCR-MT has received RRCReestablishment. |
| Qualcomm | We discussed the issue where the NCR-MT reselects a new cell while in INACTIVE state, in which case the NCR-FWD is turned OFF.  A similar issue occurs if the **NCR-MT reselects a different beam of the same camped cell** while in INACTIVE state. In this case, the last received configuration may no longer be valid (i.e., the NCR FWD may forward the wrong SSB) and the NCR-FWD should be turned OFF until the NCR-MT resumes and receives new side control configuration. |
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# Conclusion

To be updated

# References

[1] RAN2#120 Chairman notes