**3GPP TSG-RAN2 Meeting #116-e R2-21xxxxx**

**Online, November 1st – 12th, 2021**

**Agenda Item: 9.1.2**

**Source: Huawei**

**Title: Summary of [301] RLF measurements (Huawei)**

**Document for: Discussion and decision**

# Introduction

This document is the report of the offline discussion “[Post115-e][301][NBIOT/eMTC R17] RLF measurements (Huawei)” as below:

* [Post115-e][301][NBIOT/eMTC R17] RLF measurements (Huawei)

 Scope: Progress the FFSs

 Intended outcome: Report to next meeting

 Deadline for comments: October 14th, 0900 UTC

 Deadline for summary: October 21st, 0900 UTC

The agreements of RAN2#115-e [1] are summarised below and the remaining FFSs highlighted.

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| --- |
| RAN2#115-e agreements: * The configuration of the criteria for starting the measurements include a serving cell NRSRP threshold. FSS how to address variance (as agreed last meeting)
* It is useful to have a shorter T310 timer for UEs supporting this enhancement, but FFS whether this is best achieved with the existing dedicated signalling or based on a new condition.
* Prioritisation of carriers/cells to measure is left to the UE implementation.
* FFS: whether to provide a separate criteria for inter-frequency measurements (i.e. needing re-tuning) considering that they will take longer and should start earlier.
* Legacy relaxed monitoring criteria is reused to address the variance part of the criteria to start the measurements.
	+ - FFS: Whether it is enabled by the provision of separate SSearchDeltaP and TSearchDeltaP parameters from RRC\_IDLE.
* The conditions where the UE is required to perform measurements are specified. No requirement on when to stop measurements is needed.
* The configuration of the criteria for starting the measurements is provided via broadcast signalling.
* Provision of information regarding which cells/carriers to be considered is not supported. It is up to UE implementation to choose and prioritize carrier/cell list for measurement.
* Report of the cells measured in RRC\_IDLE to assist measurement configuration is not supported.
* Report of information about connected measurements during the RRC Connection re-establishment procedure for network optimisation is not supported.
* There is no need to specify which subframes can be used for measurements beyond them not being needed for PDCCH monitoring or data transmission / reception.
* Support for connected mode measurement is optional with capability signalling.
* FFS: Whether to support an indication from the UE that it starts/ stops performing measurement
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This is the continuation of [AT115-e][301][NBIOT/eMTC R17] RLF measurements (Huawei) [2].

# Discussion

## Separate criteria for inter-frequency measurements

At RAN2#115-e, it has been agreed that prioritisation of carriers/cells to measure is left to the UE implementation and a FFS was raised whether to provide a separate criteria for inter-frequency measurements (i.e. needing re-tuning) considering that they will take longer and should start earlier.

**Discussion point 1:** Do you support having a separate criteria for inter-frequency measurements (i.e. needing re-tuning) considering that they will take longer and should start earlier. Please justify.

Companies’ inputs

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no**  | **Detailed comments** |
| ZTE | Yes | Similar as that in RRC\_IDLE, we assume UE can prioritize intra-frequency measurements based on a set of “easy-to-satisfy” threshold while deprioritize inter-frequency (i.e. needing re-tuning) measurements with another a bit strict set of threshold.We are not sure about the thinking that inter-frequency measurements should start earlier just because of the consideration that it may take longer. As the length of required time for measurement is related to some aspects, e.g., the amount of free sub-frames and the coverage status of the UE, it may be not easy to assume the length of required time for measurement, and also not easy to associate the configured criteria with an assumed time length.Anyway, from specification perspective, we can just allow two sets of thresholds configuration. Which configuration is strict and which is loose can be left to network implementation. |
| Huawei, HiSilicon | No | First, we think that systemwise, it does not make sense to configure different thresholds for intra-and inter-frequency measurements. This is different from RRC\_IDLE where this is related to deployment and distribution of the UEs on different frequency layers.Then, we think that the case where the UE performs intra-frequency measurements is not the common case, as this will only be true for UEs configured with the anchor carrier (which is usually used for UEs in extreme coverage due to the power boosting) or for the case where the UE is configured with a non-anchor carrier with the same frequency as the anchor carrier of a neighbour cell (which is not an usual deployment). Finally, as RAN2 has agreed that prioritisation was left to the UE implementation, if the UE finds ‘early’ a cell on its configured carrier frequency, it can just prioritise it in the measurements and only needs to keep measuring every 5s (pending RAN4). We think the impact on power consumption is negligible.  |
| Qualcomm | Yes | Configuring different criteria for inter- and intra-frequency is sensible considering:* no dedicated measurements gaps are supported
* opportunity for inter-frequency measurements will be fewer than for intra-frequency case
* criteria is configured in broadcast signalling hence allows for different UEs to apply one of the two criteria based on the downlink dedicated carrier e.g., if all anchors on the same carrier and UE configured with anchor carrier for dedicated would apply then intra-frequency criteria while UE configured with non-anchor carrier for dedicated would apply the inter-frequency criteria and both UE’s can then have similar re-establishment performance.
 |
| Ericsson | Yes | Similar with cell reselection criteria in RRC\_IDLE mode, serving cell quality threshold for intra and inter frequency neighbor cell measurement can be configured separately. Therefore, UE has the possibility to start inter-frequency neighbor cell measurement when serving cell quality is really bad, which is good from UE power consumption point of view without interruption on data scheduling.We agree with ZTE that inter-frequency measurements should not start earlier just because of the consideration that it may take longer. We just propose to have two separate threshold for intra and inter frequency measurement.  |

## Enabling of relaxed monitoring enabled in RRC\_CONNECTED

At RAN2#115-e, it has been agreed that legacy relaxed monitoring criteria is reused to address the variance part of the criteria to start the measurements and a FFS was raised whether it is enabled by the provision of separate SSearchDeltaP and TSearchDeltaP parameters from RRC\_IDLE.

In RRC\_IDLE, relaxed monitoring is enabled by the provision of *s-SearchDeltaP* in SIB3-NB:

CellReselectionInfoCommon-NB-v1450 ::= SEQUENCE {

 s-SearchDeltaP-r14 ENUMERATED {dB6, dB9, dB12, dB15}

}

And 36.304 specifies that TSearchDeltaP = 5 minutes or the eDRX cycle length if eDRX is configured and the eDRX cycle length is longer than 5 minutes.

During the email discussion at RAN2#115 [2], most companies indicated that the parameters could be different from RRC\_IDLE.

**Discussion point 2-1:** Is relaxed monitoring in RRC\_CONNECTED enabled/disabled by the network ?

Companies’ inputs

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| --- | --- | --- |
| **Company** | **yes/no**  | **Detailed comments** |
| ZTE | **Yes** for measurement enabled/disabled by the network, but it’s not suitable to say for relaxed monitoring | We are not sure whether it’s suitable to say relaxed monitoring in RRC\_CONNECTED. There is no such concept. We just re-use (part of) the criteria in relaxed monitoring in RRC\_IDLE for checking the variance of serving cell quality in RRC\_CONNECTED.Furthermore, as RAN2 has agreed the configuration of the criteria for starting the measurements (including absolute threshold for serving cell quality and the threshold for the variance of serving cell quality) is provided via broadcast signalling, we understand the values of *s-SearchDeltaP* and *TSearchDeltaP* for RRC\_CONNECTED would be common for all the UEs. But we think introducing indication(s) in dedicated signalling to enable/disable connected mode measurement would be beneficial, at least for IoT test. Moreover, with such indication, the network can enable only a part of the UEs to perform measurement. |
| Huawei, HiSilicon | yes | This is a general principle that idle mode mechanisms are enabled by the NW. Note that it is the same for relaxed monitoring in RRC\_IDLE.We think it should be possible for the NW to enable connected mode measurements without enabling the conditions on the serving cell quality variance. One reason we see is that it can be difficult to set appropriate values e.g. for UEs with relatively short connection . |
| Qualcomm | No | We think the relaxed monitoring criteria in RRC\_CONNECTED should be enabled provided relaxed monitoring criteria is configured. We see no reason for network to explicitly enable/disable this for RRC\_CONNECTED state. |
| Ericsson  | No | We think there is no need to enable/disable this variance criteria for each dedicated users. It should be common for all and should be broadcasted as previous agreement.  |

**Discussion point 2-2:** Can the values of *s-SearchDeltaP* and *TSearchDeltaP* be different in RRC\_CONNECTED and RRC\_IDLE? if yes, how are they provided?

Companies’ inputs

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| --- | --- | --- |
| **Company** | **yes/no**  | **Detailed comments** |
| ZTE | Yes | RAN2 has agreed to provide the criteria, e.g., *s-SearchDeltaP* and *TSearchDeltaP* via broadcast signalling. Therefore, the criteria would be common to all the UEs. But we think it should be different for RRC\_CONNECTED and RRC\_IDLE. For example, *TSearchDeltaP* can be shorter for RRC\_CONNECTED. For *s-SearchDeltaP*, it may be larger for RRC\_IDLE as the purpose is try to reduce the measurement. But for RRC\_CONNECTED, it may have two purposes of triggering measurement and avoiding unnecessary measurement, so it can be a bit small.  |
| Huawei, HiSilicon | yes | We think that the timeline in RRC\_CONNECTED is very different from RRC\_IDLE and the serving cell measurements are performed more frequently as in RRC\_IDLE (e.g. every 800ms for UE in normal coverage according to TS 36.133 section 8.14), so at least *TSearchDeltaP* willbe different. Whether TSearchDeltaP is signalled or predefined in the specification needs to be discussed. If signalled, we assume it will be a new parameter in SIB3. For *s-SearchDeltaP,* we think it might be the same or different in RRC\_CONNECTED and RRC\_IDLE. Considering that the existing signalling is only 2 bits we do not see the need for any signalling optimisations, so it is simpler to signal the value separately for connected mode. |
| Qualcomm | Yes | We think it should be possible to configure different values for *s-SearchDeltaP* and *TSearchDeltaP* for RRC\_CONNECTED mode. If a different value for RRC\_CONNECTED mode is not configured but R14 values are configured then UE should use the R14 thresholds. |
| Ericsson | Yes | Below is the table for 36.133, when Rmax > 64, TEvaluate\_Qout\_NB-IoT = 4s, assume N310 is set to 20 and T310 is 8s, then the time slot from the first out of sync to RLF declaration is about 88s, which is much less than TSearchDeltaP. Considering starting UE measurement early before RLF, it’s beneficial to set TSearchDeltaP to a small value than legacy and make it as configurable. **Table 7.23.2.1-1 Qout and Qin c in non-DRX for Category NB1 UE**

|  |  |  |
| --- | --- | --- |
| **Configured NPDCCH Rmax** | **TEvaluate\_Qout\_NB-IoT** | **TEvaluate\_Qin\_NB-IoT** |
| Rmax ≤ 64 | 400ms | 200ms |
| Rmax> 64 | 4000ms | 2000ms |

Regarding the variance part of the criteria to start the measurements, legacy SSearchDeltaP from RRC\_IDLE can be reused or can be different, while separate TSearchDeltaP should be introduced as configurable by *SIB3-NB*. |

## UE indication that it starts/stops measurements

At RAN2#115-e, it has been discussed and left FFS whether to support an indication from the UE that it starts/ stops performing measurements.

**Discussion point 3:** Do you support having an indication that the UE starts measurement, please justify? If yes, how is it reported?

Companies’ inputs

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| --- | --- | --- |
| **Company** | **Yes/No** | **Detailed comments** |
| ZTE | No | Based on our analysis, we see it’s already possible for network to provide suitable configuration to facilitate UE to perform connected mode measurement without interrupting the service transmission. For UE side, when the criteria for starting connected mode measurement is fulfilled, UE can just perform the measurement in the scheduling gap (e.g., making use of the free sub-frames). Moreover, as long as the measurement is started, UE can try to complete the measurement at least once and stop the measurement after getting the results. In short, we see no any issue without notifying the measurement start/stop to the network.On the other hand, if introducing such start/stop indication(s), the time duration between the start and stop indications can be seen as kind of “measurement gap” detemined by the UE. In such “measurement gap”, the network would completely stop scheduling for the UE. We see it’s not good for service performance and user experience. Moreover, to introduce such measurement start/stop indications may have considerable specification impacts and cause signalling overhead. It may be not only to define only two indications, but also need to further consider the acknowledgement of the start/stop indications in order try to avoid any possible inconsistence between UE and network. |
| Huawei, HiSilicon | No | First we think the enhancement is targeted to mobile UEs, i.e. UE in normal coverage and thus the gaps required should be relatively short (e.g. 400 ms pending RAN4). Thus, the important part is that the eNB provides the UE with a DRX/ PDCCH search space configuration which will allow sufficient time for the UE to perform measurements when it is not scheduled. This can be done by eNB knowing that the UE supports the enhancement.Then we think that the NW can observe the degradation of the quality and adapt, by implementation, the scheduling for the UEs that support the enhancements.Finally, we think that defining a new procedure / signalling for reporting will have a quite large impact on specification / power consumption / signalling overhead, which is not justified. |
| Qualcomm | **Yes** | We consider it is useful for UE to be able to indicate UE needs to perform inter-frequency measurements. Such an indication would help:1. Maintain maximum throughout for UEs that do not need to perform such measurements.
2. Scheduling ensures there are sufficient opportunities for UEs that **need** to perform inter-frequency measurements.

Remember:* the only purpose of this objective in the WID is to maintain good data throughput when RLF happens. As there are no dedicated gaps for inter-frequency measurements, scheduling needs allow sufficient opportunities for inter-frequency measurements.

In the real world even though an operator may configure all anchor carriers on the same frequency, it would be a common a UE is configured with non-anchor dedicated downlink carrier hence the solution should provide benefit to UEs configured as such. |
| Ericsson  |  | We think it is not necessary for UE to send this kind of report, one reason is that the natural gaps proposed by RAN4 may be enough for measurement, even not, UE can continue perform neighbor cell measurement after RLF. Besides the radio link condition are bad so UL Tx may fail.But we would like to understand as when and how UE will send this. It may ofcourse be good for the NW to know but not essential. |

## Shorter T310 timer

At RAN2#115-e, it was agreed ‘It is useful to have a shorter T310 timer for UEs supporting this enhancement, but FFS whether this is best achieved with the existing dedicated signalling or based on a new condition”. This was further discussed in offline [310] without conclusion [2].

Based on the previous discussions, the two options are clarified as below:

1. Existing signalling: eNB configures a shorter value of *t310-r13* in *rlf-TimersAndConstants-r13.* T310 timer is handled as per legacy, no impact on the specification.
2. New condition: New timer, e.g. *t310bis-r16*, configured by the eNB, which value the UE uses when starting T310 if the condition is fulfilled. Further handling of T310 timer is as per legacy. Signalling of the timer to be discussed.

**Discussion point 4-1:** Is the support of connected mode measurement a sufficient condition for a shorter T310? If no, clarify what additional condition is needed.

Companies’ inputs

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| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| ZTE | No(here “No” means we prefer option a) and see no any additional condition is needed for applying dedicated T310. “No” doesn’t means the condition of supporting of connected mode measurement is needed while other conditions are not needed) | We prefer the option a) and think whether and when to configure a shorter T310 can be left to network implementation. No need to further discuss the condition for configuring a shorter T310. For UE side, we think UE should follow the dedicated configuration if it’s provided. Therefore, it’s also no need to further discuss the condition for the UE to apply a shorter T310. In short, configuring/applying the dedicated T310 timer don’t need to depend on whether the UE supports connected mode measurement or any other condition.With the following reasons, we prefer to use existing dedicated T310 timer provision and no need to define any aditional condition(s) or any other new timer.1. The current dedicated signalling can already allow shorter T310 timer configuration for a certain UE, e.g., according to UE’s coverage. If a UE is in very good coverage, it’s much likely to be configured with shorter T310, e.g., 2s. But if the UE’s coverage is already not so good, it may be configred with a bit longer value (still can be shorter than 8s). This is already with consideration for trade-off between quick reselection to new cell and enough time for recovery (in a not so good coverage, DL/UL repetitions are anyway needed for in-sync indications reception).
2. Even we can have a kind of common understanding that R17 UEs may be with continuous movement, there may have no common assumption on the long connection. It’s still possible for UE to only have a few data for transmission, the each time connection may be not long. For such UE, it’s likely to use CP solution and we can assume the dedicated T310 configured at each RRC establishment procedure would be always suitable during the whole connection. If UE has more data for transmission, it’s likely to use UP solution and maintain long connection. For such UE, the situation may change a lot. When such case occurs, it’s possible for network to reconfigure the UE with another suitable T310 value. Moreover, we don’t think network need to rely on UE’s report, the evaluation on DL/UL service quality can provide enough information to network.
3. In previous contribution, companies also mentioned using a shorter T310 will reduce the chance of recovery for UEs not at the cell edge and experiencing temporary bad radio conditions. They think shorter T310 should be avoided in this case. We disagree. We cannot see big difference between using 2s and 8s. Taking the whole RLF procedure into consideration, for a **temporary** radio condition deterioration, the “recovery” may happen at any stage. The only case with benefit of long T310 may be that the "in-sync" indications are received after the T310 runs for 2s but before 8s. We think it would be very rare case. With following thoughts, it’s hard to say benefit of long T310 (or hard to say the drawbacks of short T310):
	* The UE may not receive enough N310 consecutive "out-of-sync" indications to trigger T310. Then it doesn't matter to use T310 of 2s or T310 of 8s.
	* "in-sync" indications occurs late, e.g., just after start of T310. Since the UE is originally in good coverage (not at the cell edge), 2s may be still enough for UE to receive them.

In a summary, without crystal clear benefit, such complexity of handling additonal condition or additional (third) timer is unnecessary. |
| Huawei, Hisilicon | no | We think that additional conditions on UE mobility and UE expecting more data are required. Additionally, a condition on the UE having found a target cell can be considered.If the UE is stationary, the likeness that RLF will actually occur is low. If the UE is not expecting any more data, then it is better to wait and hope that the connection will terminate normally, this would avoid re-establishment all together. This is why, in today deployments, T310 is set to a quite long value, as stationary UEs with short connection is the more common use case.Our proposal for a shorter timer is to address a different use case, i.e. mobile UEs with frequent transmissions such as tracking devices. For these UEs, a shorter timer will reduce the interrupt time and improve the user experience (e.g. by avoiding that the UE misses some reporting). |
| Qualcomm | **No** | We think network can configure a shorter value for *t310-r13* based on UE supports connected mode neighbour cell measurements and UE subscription information indicates UE is mobile. |
| Ericsson | b)New condition | UE should better start the timer only when there is enough predicted time reduction to RRC reestablishment. Therefore, triggering condition to start “shorter T310” can consider some conditions, e.g.* Proper neighbor cell is found
* The time difference between T310 remaining time and “shorter T310” is higher than a threshold
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**Discussion point 4-2:** If the answer to discussion 4-1 is no, does the NW need to know the additional condition is fulfilled for option a)? Please clarify.

Companies’ inputs

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| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| ZTE | No | This is purely network implementation. Nothing needs to be specified. |
| Huawei, HiSilicon  | yes | Option a) (a single timer) does not allow different values for when the condition is fulfilled and when it is not, so the eNB needs to know when configuring the timer. For the CP solution, the eNB needs to know at the time of the connection is established. Restricting the ‘enhancement’, as proposed by some companies, to the UP solution which is not deployed does not seem the right approach.Of course, the eNB can already configure different values to different UEs today, but it cannot address the mobility aspects nor the case where the UE has no additional data to transmit. |
| Qualcomm | **No** | While we understand proponents of new timer (*t310bis-r16*) want the UE to decide to use *t310bis-r16* or *t310-r13* based on whether or not UE started RRC\_CONNETED state neighbour cell measurements. We think this is a small optimisation and don’t think the complexity of two timers for the same aspect is not justified. Furthermore, what if UE starts neighbour cell measurements and starts *t310bis-r16* but UE does not get (sufficient) opportunity to do the measurements? |
|  |  |  |

**Discussion point 4-3:** If the answer to discussion 4-1 is no, does the NW need to know the additional condition is fulfilled for option b)? Please clarify.

Companies’ inputs

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| **Company** | **yes/no** | **Detailed comments** |
| ZTE | No | No need of option b).Even with option b), the condition can be purely network implementation. Nothing needs to be specified. |
| Huawei, HiSilicon | No | Option b) (signalling two different values) means that the eNB does not needs to know that the condition is fulfilled when configuring the timer(s).  |
| Qualcomm | No | See answer to question 4-1. |
| Ericsson | **No** | NW does not need to know if the condition is fulfilled or not. Just as in legacy for T310, UE can direclty declare RLF to avoid additional UE report and signaling. |

**Discussion point 4-4:** If option b) is selected, how is the new timer provided, via dedicated signalling only, via broadcast signalling only, via one and/or the other (same as existing t310-r13)? Please justify.

Companies’ inputs

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| --- | --- | --- |
| **Company** | **Dedicated/broadcast / both** | **Detailed comments** |
| Huawei, HiSilicon | both | We could just follow a similar approach to existing idle mode timers and RLF timer, i.e. the eNB optionally signals a common value in broadcast signalling and potentially a UE specific value via dedicated signalling. Up to the eNB to decide which option(s\_ to use. |
| Qualcomm | both | If option b) is selected, then we think it is reasonable to follow similar approach as for *t310-r13*. |
| Ericsson | **both** |  |
|  |  |  |

## Other

Please indicate here any other issue that you would like to raise in the email discussion.

Companies’ inputs

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| --- | --- |
| **Company** | **Comments** |
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# Conclusion

TBC

# Participants

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| --- | --- | --- |
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# References

1. R2-2108974 RAN2 agreements for Rel-17 NB-IoT and LTE-MTC Ericsson RAN2#115-e August 2021
2. R2-21089 Summary of [301] RLF measurements (Huawei) Huawei RAN2#115-e August 2021