**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-210XXXX**

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 12.1

**Source:** Moderator (Huawei)

**Title:** Email discussion summary for [98-bis-e][226] LS\_reply\_R2-2102165\_NBIOT

**Document for:** Information

# Introduction

Companies are encouraged to provided views on the questions raised in RAN2 LS R2-2102165 in the 1st and 2nd round discussion.

1st round:

Companies provide comments on issues identified in submitted contributions.

Companies provide comments on questions raised in LS R2-2102165.

2nd round:

Companies provide comments on remaining issues based on the 1st round discussion.

Companies provide comments on the draft LS reply and finalize the LS reply.

# Topic #1: Title

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104429 | ZTE Corporation | Proposal 1: It is totally feasible to conduct such measurements without gaps. The triggering condition for such measurements can be the deteriorates in the serving cell channel quality.  Proposal 2: One-shot measurement is to be used by the UE for neighbor cell measurements.  Proposal 3: Tsearch\_NB1-NC = 1400 ms for UE in normal coverage and Tsearch\_NB1-EC = 14800 ms for UE in enhanced coverage.  Proposal 4: A neighbor cell is known if it has been detected by the UE within 5 seconds.  Proposal 5: NB-IoT UE can perform measurement occasionally.  Proposal 6: The minimum length of a measurement occasion can be 21ms. In some scenarios it can be 6ms for Frame structure type 1 and 7ms for Frame structure type 2.  **Proposal 7: As to question 4, for scenario B, D and E, several measurement occasions might be needed.**  **Proposal 8: For question 5, re-use the time period defined for Question 3 and avoid any confusion.**  **Proposal 9: Agree on the answers in the table to be provided in the reply LS.** |
| R4-2106345 | Qualcomm Incorporated | **Proposal 1: The UE would be able to perform neighbor cell measurements in RRC\_CONNECTED in scenarios A and C, assuming that no interruptions in traffic are allowed.**  **Proposal 2: RAN2 may refer to the re-establishment delay requirements for NB-IoT UEs in TS 36.133 sections 6.5.2.1 and 6.5.2.2. The search times are defined by Tsearch\_NB1-NC and Tsearch\_NB1-EC.**  **Proposal 3: RAN4 to discuss which definition of known cell to use for the new neighbor cell measurement requirements for NB-IoT UEs. At least two candidate options, one for LTE UEs and one for Cat M1 UEs, may be considered.**  **Proposal 4: RAN2 may refer to the intra-frequency measurement period requirements in RRC\_CONNECTED in TS 36.133 sections 8.14.2 and 8.14.3. The measurement period without DRX is either 800 ms and 1600 ms depending on the type of coverage. With DRX the measurement period (= 5 DRX cycles) ranges from ~1.3 s to ~50 s depending on the DRX cycle duration.**  **Proposal 5: RAN4 could consider at least the following options for measurement validity:**   1. **A NRSRP measurement would be considered valid if it was performed within the last 5 seconds, leveraging the definition of known cell for LTE UEs.** 2. **A NRSRP measurement would be considered valid for a period of time equal to N times the measurement period, where N is TBD.** |
| R4-2106857 | Ericsson | **Proposal #1: Upon starting of RLF timer (T310) or detecting an X number of out-of-sync indications, the UE starts detecting and measuring on the target intra-frequency cell anytime, X is TBD.**  **Proposal #2: Upon starting of RLF timer (T310) or detecting an X number of out-of-sync indications, the UE starts detecting and measuring on the target inter-frequency cell during the DRX inactive period if currently served by a non-anchor carrier.**  **Proposal #3: Upon starting of RLF timer (T310) or detecting an X number of out-of-sync indications, the UE starts detecting and measuring on the target inter-frequency cell during the DRX inactive period excluding subframes (#0, #4, #5 in every frame and #9) if currently served by an anchor carrier.**  **Proposal #4: Time required to perform cell detection and a measurement on another cell in normal and enhanced coverage are 1400 ms and 14800 ms respectively in non-DRX.**  **Proposal #5: Time required to perform cell detection and a measurement on another cell in normal and enhanced coverage are as defined in Table 1 and 2 for normal and enhanced coverage respectively in DRX.**  **Proposal #6: A NB-IoT cell is considered known if it has been meeting the relevant cell identification requirement for a time duration equal to or longer than the time duration required for the cell identification (Tsearch). Otherwise, the cell is considered unknown.**  **Proposal #7: The non-DRX measurement delay for NRSRP on intra-frequency serving cell is as follows:**   |  |  |  | | --- | --- | --- | | **Coverage mode** | **Measurement period** | | |  | **NRS based NRSRP** | **NSSS based NRSRP** | | **Normal coverage** | **800 ms** | **1600 ms** | | **Enhanced coverage** | **1600 ms** | **1600 ms** |   **Proposal #8: The DRX measurement delay for NRSRP on intra-frequency serving cell comprises of 5 DRX cycles for both normal and enhanced coverage.**  **Proposal #9: How long NRSRP measurement can be considered valid depends on many factors including UE mobility state (e.g. static or moving) and also on the intended use case.** |
| R4-2106985 | Huawei, HiSilicon | **Proposal 1: RAN4 provide the time duration needed for detection and measurement on a certain frequency layer.**  **Proposal 2: For scenario A and C, UE could perform measurement on neighbour anchor without measurement gap. For scenario B, D and E, UE could perform measurement on neighbour anchor without measurement gap provided that the UE is not required to do data transmission/reception or NPDCCH monitoring during the time period for detection and measurement.**  **Observation 1: Provide the same time duration needed for detection/measurement for all scenarios.**  **Observation 2: Neighbour cell detection and measurement before RLF in a more intensive manner needs to be considered; otherwise, it will take a long time to detect the Cell and UE may already enter the RRC Re-establishment process.**  **Proposal 3: For normal coverage, for scenario A-E, the time needed for cell detection or measurement is 800 ms. For scenarios B, D and E, the length of a single available time period for detection or measurement shall be at least 400 ms, and the maximum interval between two available time periods for detection/measurement on the cell shall be less than 5 seconds.**  **Observation 3: The benefits of neighbour cell measurement in enhanced coverage before RLF is limited in time reduction for RRC Re-establishment.**  **Proposal 4: Focus on neighbour cell measurement before RLF in normal coverage and provide the observations to RAN2 in the LS reply.**  **Observation 4: The overall time for neighbour cell detection and measurement will be longer if UE is configured to perform neighbour cell measurement on multiple frequency layers, and the maximum interval between two available time periods shall be scaled.**  **Proposal 5: The neighbour cell can be considered as known if it has been measured within the last 5 seconds and during which the cell remains detectable.** |
| R4-2107185 | Nokia, Nokia Shanghai Bell | 1. **The search time for target cell and system information acquisition related delay are the major contributors to the re-establishment delay.** 2. **The target cell search time depends on whether the target cell is known or unknown. In case it is known, it is 0 s, else it can vary between 80 and 1400 ms in normal coverage and between 80 and 14800 ms in enhanced coverage.** 3. **The system information acquisition delay needs to be added for unknown target cells. It depends on the system information scheduling in the target cell (MIB and SIB1 are at least required) and the required number of repetitions for each system information block which will further increase the time required to identify the target cell.** 4. **The depicted scenarios in the LS covering intra-frequency and inter-frequency target cells are quite different and need to be distinguished. The number of target cells to be measured prior RLF will also impact the measurement time.** 5. **Intra-frequency measurement requirements for RRC\_CONNECTED state for NB-IoT UE are specified in TS 36.133 whilst inter-frequency measurement requirements are not specified. Normal and enhanced coverage requirements are distinguished.** 6. **Whether the UE is capable to measure the cells prior to RLF, depends on several conditions:**  * **whether the UE is in normal coverage or in enhanced coverage determining the search time for target cells** * **whether the target cell is known or not** * **whether the target cell is on intra-frequency layer or inter-frequency layer** * **the system information scheduling and the number of required repetitions in the target cell the UE needs to receive** * **the number of target cells the UE is to measure** * **the DRX cycle in RRC\_CONNECTED mode** * **the network deployment.**  1. **RAN2 to provide further information on the considered scenarios regarding the listed conditions in above observation 6.** 2. The use of measurement gaps should not be excluded at this stage to enable full network control. |

## Open issues summary

The inputs from companies are summarized according to the questions raised in RAN2 LS in the following sub-topics. Some genenarl issues are summarized in sub-topic 1-0 based on companies’s contributions. The poposed respones to the Q1-Q5 in RAN2 LS are summarized in sub-topic 1-1 to 1-5.

### Sub-topic 1-0 General

**Issue 1-0-1: Neighbour cell measurement triggering**

* Proposals
  + Option 1: The triggering condition for such measurements can be the deteriorates in the serving cell channel quality. (ZTE P1)
  + Option 2: UE starts detection and measurement upon starting of RLF timer (T310) or detecting an X number of out-of-sync indications, X is TDB. (Ericsson P1/2/3)
* Recommended WF
  + Need more discussion

**Issue 1-0-2: Feasibility of measurement gap**

* Proposals
  + Option 1: The use of measurement gaps should not be excluded at this stage to enable full network control (Nokia P2)
* Recommended WF
  + Need more discussion

**Issue 1-0-3: Feasibility of neighbour cell measurement in enhanced coverage**

* Proposals
  + Option 1: Focus on neighbour cell measurement before RLF in normal coverage and provide the observations to RAN2 in the LS reply. (Huawei O3 P4)
* Recommended WF
  + Need more discussion

**Issue 1-0-4: Measurement approach**

* Proposals
  + Option 1: One-shot measurement is to be used by the UE for neighbor cell measurements. The measurements can be done occasionally. (ZTE P2 P5)
* Recommended WF
  + Need more discussion

**Issue 1-0-5: Conditions for neighbour cell measurement to be considered:**

* Proposals
  + Option 1: (Nokia P1 O6)

Whether the UE is capable to measure the cells prior to RLF, depends on several conditions:

* + - whether the UE is in normal coverage or in enhanced coverage determining the search time for target cells
    - whether the target cell is known or not
    - whether the target cell is on intra-frequency layer or inter-frequency layer
    - the system information scheduling and the number of required repetitions in the target cell the UE needs to receive
    - the number of target cells the UE is to measure
    - the DRX cycle in RRC\_CONNECTED mode
    - the network deployment.
* Recommended WF
  + Need more discussion

**Companies views’ collection for 1st round for Sub-topic 1-0 (General)**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-0-1**  **Issue 1-0-2**  **Issue 1-0-3**  **Issue 1-0-4**  **Issue 1-0-5** |
| ZTE | **Issue 1-0-1:** The two options are actually quite similar. We can first agree on a principle to use degradation in channel condition as the triggering condition and then further study which specific criterion to use.  **Issue 1-0-2:** Is this related to Issue 1-1-1 where all companies proposed that measurement can be done without gaps? Then why do we need gaps?  **Issue 1-0-3:** In the LS from RAN2, enhanced coverage was also listed as a scenario. Thus, RAN4 should try to also answer related questions.  **Issue 1-0-4:** Support Option 1.Without gaps, continuous measurement may not be guaranteed, thus we propose to use one-shot measurements.  **Issue 1-0-5:** We suggest to limit the discussion to the scope to cover questions raised by RAN2. Option 1 here seems a bit complicated and vague, for instance, what does the network deployment refer to? |
| Ericsson | **Issue 1-0-1**  We would like to support option 2 that is based on detecting X number of out-of-sync indications, where the value of X can be further discussed in RAN4. Conditioning on RLF (T310) timer to start the neighbour cell measurements might be too late. Since RLF is triggered when N310 consecutive out-of-sync indications are triggered, UE may have enough time to complete the measurements of the neighbour cells if out-of-sync indications are used as the trigger. Hence, we support a revised of option 2 that is dependent on detecting X number of out-of-sync indications.  Option 1 will require new quality metric. Therefore compared to option 1, option 2 is more concrete and does not require any new quality metric.  In addition, it is also equally important to stop the measurements on the neighbour cells when there is no need for that, e.g. when the UE is in good condition wrt serving cell. Otherwise, it will result in unnecessary power consumption. The UE should stop the measurements when Y number of in-sync indications are detected. RAN4 can further discuss the values of X and Y.  **Issue 1-0-2**  In our understanding, the WI objective has excluded the use of gaps for neighbour cell measurements and corresponding trigger before RLF, see below:   * ***“****Specify signaling for neighbor cell measurements and corresponding measurement triggering before RLF, to* *reduce the time taken to RRC reestablishment to another cell, without defining specific gaps. [NB-IoT] [RAN2, RAN4].****“***   Therefore, RAN4 should discuss measurement scenarios and solutions which do not require measurement gaps.  **Issue 1-0-3**  We would like to support the neighbour cell measurements before RLF in both normal and enhanced coverage.  **Issue 1-0-4**  We do not support use of with one-shot measurements. The NB-IOT measurement requirements have been derived based on a lot simulation studies that went on for many meetings in release 13. There were reasons to define the measurement requirements based on multiple samples and averaging. The neighbouring cell measurements that are currently discussed should leverage on that. Therefore we do not support the use of one-shot measurements as it can clearly impact the accuracy and the reliability of the measurements when used in other procedures.  **Issue 1-0-5**  We do not understand the intention of this proposal. However, we agree that the conditions or the requirements might be different depending on the cases that are listed in option 1. For example, if the cell is already known then there is no need to perform PSS/SSS acquisition and instead the UE can start the measurement directly. Also the way the measurements are done may depend on whether the carrier is an intra-frequency or inter-frequency carrier etc. |
| Huawei: | **Issue 1-0-1**  How the neighbour cell measurement is triggered is under discussion in RAN2 currently, and RAN4’s input regarding the questions from RAN2 is expected to help the design about the mechanism of the neighbour cell measurement. Then we should focus the question raised in RAN2’s LS, and this is out of RAN4’s discussion.  **Issue 1-0-2**  Similar views as Ericsson. It is already clarified in the WID that specific gap will not be defined. Then we think there is no need to discuss it in RAN4.  **Issue 1-0-3**  As analysed in our paper, the time for cell searching is much longer than in normal coverage. If UE take the time to search a cell in enhanced coverage, then the RLF may already happen, then the delay reduction in the RRC re-establishment by enabling the neighbour cell measurement is quite limited. As the available measurement occasion is occasionally present without gap, then UE shall make full usage of the occasions find a cell in good coverage. We also provide values in enhanced coverage. We are fine to provide RAN4’s response for both normal and enhanced coverage, but also accompanied with the observation that the usage of neighbour cell measurement in enhanced coverage is limited from RAN4’s perspective.  **Issue 1-0-4**  Firstly, we are not very clear about the meaning of “one-shot” here. Does it means UE performs the neighbour cell measurement only once when it is triggered? In this case, we think “one-shot” measurement is not applicable. As if UE completes the single neighbour cell measurement and a suitable cell is founded, it may take some time before the RLF is triggered. Then according to the definition of a known cell, the cell may not be considered as known when UE enters the RRC re-establishment procedure.  If “one-shot” means UE shall do consecutive measurement and detection, then we can agree with it in some degree. For example, if the neighbour cell measurement is triggered, UE shall try it best to find a suitable cell before RLF happens. Then if UE find there is a time period without data (e.g. long DRX inactive period), then UE shall try to use this period for consecutive detection and measurement instead of only having several samples.  **Issue 1-0-5**  The proposal is not very clear to us. We agree that whether UE could perform neighbour cell measurement depends on different factors. We suggest to focus on the questions raised by RAN2 and consider these factors directly in the following issues. |
| ZTE | **Issue 1-0-4:** We still support Option 1.The reason is that without gaps, continuous measurement may not be guaranteed, thus we propose to use one-shot measurements.  To Ericsson: I think here we’re discussing a new measurement type, and we will check if the current requirements are applicable to this new measurement. I agree that requirements which are already defined should not be impacted, but here we’re discussing a new type of measurement. In our view this new form of measurement would require new requirements (if necessary), rather than directly re-using current requirements.  To clarify, the requirements mentioned by Ericsson refer to the requirements in IDLE mode. However, if we look at RRC re-establishment, the process comprises of cell detection and one shot RSRP measurement. Thus, one shot measurement is actually used in some of the procedures. |
| Nokia | **Issue 1-0-1:** We share the view that degrading channel quality is a trigger for starting neighbour cell measurements. Starting this with timer T310 may be rather late, especially in enhanced coverage. So out-of-sync-indications in a certain time interval may be used as a trigger, but also NRSRP or channel quality thresholds may be configured. In our view this needs to be addressed by RAN2.  **Issue 1-0-2:** We still support option 1. The RAN2 LS depicts intra- and inter-frequency scenarios in RRC CONNECTED mode, where the UE might be scheduled for traffic. This is the rationale for our proposal not to exclude measurement gaps at this stage. It is true that the WID specifies the enhancement without measurement gaps, hence the use cases will shrink. Inter-frequency scenarios D and E require longer measurement time than intra-frequency scenarios A to C and hence further study is needed if natural gaps are sufficient to avoid collision with scheduled data.  **Issue 1-0-3:** We support option 1. Given our analysis, the target cell search time considerably increases in enhanced coverage, which means that the neighbour cell search / measurement must start considerably earlier than in normal coverage, and it will be more challenging to identify the trigger criterion.  **Issue 1-0-4:** We agree to other companies view, that single shot measurement is not appropriate. The measurement should be comparable to target cell identification during cell reselection, where multiple samples, spaced in time, are used.  **Issue 1-0-5:** The motivation for this proposal was to depict the different use cases. The LS from RAN2 in fact defines a multiplicity of scenarios/use cases for these neighbour cell measurements and a single solution is unlikely to cover all scenarios. In our view RAN4 should ask further clarification from RAN2 which scenarios should be prioritized or provide RAN2 with a view on which scenarios could be prioritized or are considered feasible for the feature neighbour cell measurements prior to RLF. For instance, UE in enhanced coverage and inter-frequency scenarios with unknown target cells will be a very challenging scenario. |
| ZTE | **Issue 1-0-4:** Further clarify on one-shot measurement. In RRC re-establishment, the process comprises of cell detection and one shot RSRP measurement. Thus, we propose to do one-shot measurement with only one sample of RSRP and use it in later re-establishment. The reason we don’t think that the UE needs / can measure multiple samples and then combine them is that 1) NB-IoT UEs are very different than NR UEs, they won’t stay in CONNECTEd mode for too long. 2) for NB-IoT UEs, one critical thing is power consumption. Measuring multiple samples and then update the measurement results would cause more power consumption, and is not necessary in most cases. 3) no measurement gap is configured so maybe continuous measurement cannot be guaranteed. |

### Sub-topic 1-1 Q1: Can UE perform measurements on neighbour anchor for RRC reestablishment, before RLF is declared, without measurement gaps and what would the conditions be?

**Issue 1-1-1: Whether UE can perform neighbour cell measurement in scenarios A/C**

* Proposals
  + Option 1: UE can perform neighbour cell measurement without gaps (ZTE P1, Qualcomm P1, Ericsson P1, Huawei P2)
* Recommended WF
  + Can we agree on option 1?

**Issue 1-1-2: Whether UE can perform neighbour cell measurement in scenarios B/D/E**

* Proposals
  + Option 1a: UE can perform neighbour cell measurement without gaps using vacant slots not scheduled for data transmission. (ZTE P1)
  + Option 1b: UE could perform measurement on neighbour anchor without measurement gap provided that the UE is not required to do data transmission/reception or NPDCCH monitoring during the time period for detection and measurement. (Huawei P2)
  + Option 1c: (Ericsson P2 and P3)
    - UE could perform measurement on neighbour anchor without measurement gap during the DRX inactive period if currently served by a non-anchor carrier.
    - UE could perform measurement on neighbour anchor without measurement gap during the DRX inactive period excluding subframes (#0, #4, #5 in every frame and #9) if currently served by an anchor carrier.
  + Option 2: UE is not able to perform neighbour cell measurement assuming that no interruptions in traffic are allowed. (Qualcomm P1)
* Recommended WF
  + Need more discussion

**Companies views’ collection for 1st round for Sub-topic 1-1 (Q1)**

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| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-1-1**  **Issue 1-1-2** |
| ZTE | **Issue 1-1-1:** We believe the answer is yes, thus, support Option 1.  **Issue 1-1-2:** Option 1a and ib are quite similar, we can support both options. |
| Ericsson | **Issue 1-1-1**  We support option 1. However, it is better to generalize that when the carriers of serving cell and of measured neighbour cells are the same (corresponding to scenarios A and C) then UE can measure anytime without gaps and regardless of DRX. Thus option 1 needs to be revised.  **Issue 1-1-2**  We support option 1c according to which the UE can perform measurements on the neighbour cells in scenarios B/D/E (inter-frequency carriers) when configured in DRX when the serving carrier and the measured neighbour cell carriers are different. In NB-IoT, even the shortest DRX is 320 ms giving sufficient measurement opportunities during DRX OFF. Therefore, there will be no interruptions when UE measures on neighbour cells in scenarios B/D/E. |
| Huawei | **Issue 1-1-1:**  We support option 1. For Ericsson’s suggestion, we have no strong views, but it is more straightforward to use the scenarios listed by RAN2.  **Issue 1-1-2:**  We support option 1b.  For option 3, we suggest to provide some more general principles on when UE could perform neighbour cell measurement in another frequency layer (e.g. suggested in 1b not scheduled for data transmission and reception and no NPDCCH monitoring). DRX OFF duration is too limited and it should be left to RAN2 to decide which time to use. Also for the second bullet, we believe the motivation is for NPBCH/NPSS/NSSS, however UE is not needed to decode such signals in each frame, and it is up to UE’s implementation. With such restrictions, it means UE shall stay in the anchor carrier for each frame, then the neighbour cell measurement is not possible. Then some fundamental conditions should be provided to RAN2 (e.g. option 1b) instead of determine which time to use directly. |
| Nokia | **Issue 1-1-1:** We can agree to option 1, under the condition that the UE is in normal coverage.  **Issue 1-1-2:** In our view, this scenario requires further study. The case the UE is in normal coverage and one or more inter-frequency target cells are known and have sufficient quality, should be distinguished from other cases. For other cases, option 2 is realistic, given the UE needs to be prepared for receiving / transmitting data. |

### Sub-topic 1-2 Q2: How long does it take to perform cell detection both in normal and in extended coverage?

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-2-1: Time for cell detection in normal coverage**

* Proposals
  + Option 1: Time for UE to perform cell detection and measurement is 1400 ms (ZTE P3)
  + Option 2: Delay requirements for NB-IoT UEs in TS 36.133 sections 6.5.2.1 (80 ms when signal quality is sufficient for successful cell detection on the first attempt, otherwise 1400 ms) (Qualcomm P2)
  + Option 3: The time needed for cell detection is 800 ms. For scenarios B, D and E, the length of a single available time period for detection or measurement shall be at least 400 ms, and the maximum interval between two available time periods for detection on the cell shall be less than 5 seconds. (Huawei P3)
  + Option 4: (Ericsson P4 and P5)
    - Time for UE to perform cell detection and measurement is 1400 ms in non-DRX mode.
    - Time for UE to perform cell detection and measurement in DRX mode as in the table:

|  |  |
| --- | --- |
| DRX cycle length [s] | Tdetect,NB\_Inter\_ NC [s] (number of DRX cycles) |
| 0.32 | 26 (80) |
| 0.64 | 26 (40) |
| 1.28 | 51 (40) |
| 2.56 | 51 (20) |
| 5.12 | 102 (20) |
| 10.24 | 102 (10) |

* Recommended WF
  + Need more discussion

**Issue 1-2-2: Time for cell detection in enhanced coverage**

* Proposals
  + Option 1: Time for UE to perform cell detection and measurement is 14800 ms (ZTE P3)
  + Option 2: Delay requirements for NB-IoT Ues in TS 36.133 sections 6.5.2.2 (80 ms when signal quality is sufficient for successful cell detection on the first attempt, otherwise 14800 ms) (Qualcomm P2)
  + Option 3: Focus on neighbour cell measurement before RLF in normal coverage and provide the observations to RAN2 in the LS reply. (Huawei O3 and P4)
  + Option 4: (Ericsson P4 and P5)
    - Time for UE to perform cell detection and measurement is 14800 ms in non-DRX mode.
    - Time for UE to perform cell detection and measurement in DRX mode as in the table:

|  |  |  |
| --- | --- | --- |
| SCH Ês/Iot of neighboring cell: Q2 | DRX cycle length [s] | Tdetect,NB\_Inter\_ EC [s] (number of DRX cycles) |
| -15≤ Q2 < -6 | 0.32 | 256 (800) |
| 0.64 | 266 (415) |
| 1.28 | 532 (415) |
| 2.56 | 532 (208) |
| 5.12 | 1063 (208) |
| 10.24 | 1063 (104) |
| Q2≥-6 | 0.32 | 26 (80) |
| 0.64 | 29 (45) |
| 1.28 | 58 (45) |
| 2.56 | 59 (23) |
| 5.12 | 113 (22) |
| 10.24 | 113 (11) |

* Recommended WF
  + Need more discussion

**Companies views’ collection for 1st round for Sub-topic 1-2 (Q2)**

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| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-2-1**  **Issue 1-2-2** |
| ZTE | **Issue 1-2-1:** Prefer Option 1. Option 4 would introduce large delays which are not desirable. Option 3 would have significant impact to scheduling and interruption would be large under connected mode.  **Issue 1-2-2:** Prefer Option 1. Option 4 would introduce large delays which are not desirable. |
| Ericsson | **Issue 1-2-1**  **Intra-frequency neighbour cell detection (scenarios A and C):**  When the carriers of serving cell and of measured neighbour cells are the same then UE can measure without gaps and regardless of DRX. In this case, the detection delays from the current RRC re-establishment requirement which is 1400 ms can be reused.  **Inter-frequency neighbour cell detection (scenarios B, D, E):**  On this issue we have listed the existing requirements for cell detection in IDLE mode as reference. This gives an idea of how many samples/attempts are needed to correctly detect the cell when configured in different DRX cycles. It shall be noted that the delays shown in option 4 are based on the assumption that UE does an attempt/sample once every DRX cycle, and therefore the delay is expressed in terms of number of DRX cycles. This may, however, not work well in this case where the purpose is to detect he neighbour cell fast before RLF and to reduce the time taken to perform RRC re-establishment. Therefore the inter-frequency carriers can be measured in DRX with more frequent sampling/detection attempts compared to in IDLE mode. For example, the UE may attempt detection every 20 ms, 40 ms or 80 ms in DRX instead of once every DRX cycle as in IDLE mode. This will lead to the neighbour cells are detected faster in DRX while not interrupting the serving cell operation. Following this approach where the number of samples/attempts in IDLE mode tables are used as reference, it is possible to derive a total fixed delay. For example, in DRX cycle 0.32 s, UE needs to measure 80 times according to IDLE mode requirements. Assuming the same number of samples but with more frequent sampling (e.g. 20 ms), it yields a total delay of 1600 ms. We can also accept the delay of 1400 as proposed in option 2.  **Issue 1-2-2**  **Intra-frequency neighbour cell detection (scenarios A and C):**  When the carriers of serving cell and of measured neighbour cells are the same then UE can measure without gaps and regardless of DRX. In this case, the detection delays from the current RRC re-establishment requirement which is 14800 ms can be reused.  **Inter-frequency neighbour cell detection (scenarios B, D, E):**  On this issue we have listed the existing requirements for cell detection in IDLE mode as reference. This gives an idea of how many samples/attempts are needed to correctly detect the cell when configured in different DRX cycles. It shall be noted that the delays shown in option 4 are based on the assumption that UE does an attempt/sample once every DRX cycle, and therefore the delay is expressed in terms of number of DRX cycles. This may, however, not work well in this case where the purpose is to detect he neighbour cell fast before RLF and to reduce the time taken to perform RRC re-establishment. Therefore the inter-frequency carriers can be measured in DRX with more frequent sampling/detection attempts compared to in IDLE mode. For example, the UE may attempt detection every 20 ms, 40 ms or 80 ms in DRX instead of once every DRX cycle as in IDLE mode. This will lead to the neighbour cells are detected faster in DRX while not interrupting the serving cell operation. Following this approach where the number of samples/attempts in IDLE mode tables are used as reference, it is possible to derive a total fixed delay. For example, in DRX cycle 0.32 s, UE needs to measure 800 times according to IDLE mode requirements. Assuming the same number of samples but with more frequent sampling (e.g. 20 ms), it yields a total delay of 16 seconds for the case when the measured neighbour cell in enhanced coverage.  We can also accept the delay of 14800 ms as proposed in option 2 for the case when the measured cell is in normal coverage. |
| Huawei | **Issue 1-2-1:**  We support option 3. First, for other options, companies prefer to refer to the time for cell searching in existing spec (1400 ms and 14800 ms). However it is the time for **detection + measurement**. For detection alone or measurement alone, we propose 800 ms each.  Some response to ZTE:  The motivation of option 3 is not to limit the scheduling, instead it means UE shall use the time period during which UE is not scheduled, and no interruptions will be caused in this way. As there is no specific gap, it means the measurement occasions could not be guaranteed. If UE perform the detection for 400 ms, and then the next available occasion appears 10 second later, then UE is no able to continue the detection procedure. This works as the conditions as no specific gaps.  Some response to Ericsson:  Similar views as our comments in issue 1-1-2. Focusing on DRX off period is too limited to answer the question from RAN2. If UE is in non-DRX mode, then what time will UE use to do the detection in another frequency layer?  Regarding the DRX case in IDLE mode, we think things are quite different here. First, in IDLE mode, UE can do cell detection in on-duration to save power, but in neighbour cell measurement UE shall NOT do detection in on-duration to avoid interruptions on serving cell. Second, for C-DRX, it is possible that UE is scheduled in the whole DRX cycle which means UE may don’t have time to switch to another frequency layer for detection. For cell reselection in IDLE mode, the DRX cycle means UE only need to detect NPDCCH in on duration. But for C-DRX, the data transmission/reception could occupy quite long period. No matter how long the DRX cycles is, it doesn’t equal to the available time period for UE to do the measurement without data.  So we think it is not appropriate to answer this question in terms of DRX like IDLE mode. We should provide the time needed for cell detection in a more straightforward way and let RAN2 to decide which time UE could use to perform the neighbour cell measurement. If we provide the response in form of the DRX cycles, it is not clear to RAN2 what is the exact time needed to detect a cell as the DRX table already considers some relaxations in IDLE mode. And it is RAN2 to evaluate and design which time to use to do the cell detection and measurement. If we just give the answer, for instance, 10 DRX cycles to detect a cell, we believe RAN2 is not clear how to have the design.  **Issue 1-2-2:**  Similar views as 1-2-1, we provide 8000ms for detection in our paper. But we suggest to focus on the normal coverage. As analysed in our comments in issue 1-0-3, the benefits are quite limited to let UE do cell detection for a cell in enhanced coverage. As the available measurement occasion is occasionally present without gap, then UE shall make full usage of the occasions find a cell in good coverage. |
| Nokia | **Issue 1-2-1:** Option 2 can be used as starting point. Requirements in 8.14.2 only apply to intra-frequency measurements.  **Issue 1-2-2:** Option 2 can be used as starting point. Requirements in 8.14.3 only apply to intra-frequency measurements. |

### Sub-topic 1-3 Q3: For how long the neighbour cell can be considered as known after it has been detected/re-confirmed?

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-3-1: Known cell conditions**

* Proposals
  + Option 1a: A neighbor cell is known if it has been detected by the UE within 5 seconds (ZTE P3)
  + Option 1b: The neighbour cell can be considered as known if it has been measured within the last 5 seconds and during which the cell remains detectable (Huawei P5)
  + Option 2: A NB-IoT cell is considered known if it has been meeting the relevant cell identification requirement for a time duration equal to or longer than the time duration required for the cell identification (Tsearch). Otherwise, the cell is considered unknown. (Ericsson P6)
  + Option 3: More discussion among option 1a/1b and option 2. (Qualcomm P3)
* Recommended WF
  + Need more discussion

**Companies views’ collection for 1st round for Sub-topic 1-3 (Q3)**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-3-1** |
| ZTE | **Issue 1-3-1:** Support Option 1a. Slightly prefer the wording in 1a compared to 1b. |
| Ericsson | **Issue 1-3-1**  We support option 2 which is similar to approach used in eMTC requirements. In both NB-IOT and eMTC, the simulation assumptions for deriving the cell detection requirements was based on low oppler and UE characteristics (e.g. number of receive antennas, smaller BW, etc.). The 5 seconds, on the other hand, as stated in option 1a and 1b are reused from the legacy LTE UE requirements had different assumptions (e.g. much higher oppler and 2 receive antennas), etc. Thus it is more reasonable to reuse the approach from eMTC than from legacy LTE. |
| Huawei | **Issue 1-3-1:**  We support option 1a. For option 2, the things are little bit different between NB-IoT and eMTC here. For eMTC, we have defined the specific gap to allow UE perform inter-frequency measurement. Then the identification time is deterministic. However, for NB-IoT, there will be no specific gap. Probably, UE could only use the time period without data to do neighbor cell measurement. Then if UE find a cell during neighbour cell measurement, and doesn't have the change to measure it for a long time before RLF, then we think the UE could not take this cell as known anymore. As mentioned by Ericsson, the simulation assumptions for the cell detection requirements is to decide how long or how many samples UE could get an accurate measurement results of the UE, but the known conditions is for how long UE could take the previous information as valid to directly establish the connection to the cell without searching. In some degree, option 1a/b and option 2 is similar, it is just different way to define the known conditions in the spec. We think option 1a/b is more straightforward for RAN2, and they can take the input to design how frequent the measurement should be that UE could save the searching time in RRC re-establishment. |
| Nokia | **Issue 1-3-1:** Support Option 1b. This is clearer wording than option 1a, as it refers to **last** 5 seconds, not to any 5 second interval before. |

### Sub-topic 1-4 Q4: How long does it take to perform NRSRP measurements?

**Issue 1-4-1: Time for cell measurement in normal coverage**

* Proposals
  + Option 1: The minimum length of a measurement occasion can be 21ms. In some scenarios it can be 6ms for Frame structure type 1 and 7ms for Frame structure type 2. Several measurement occasions might be needed for scenarios B,D and E (ZTE P6 P7)
  + Option 2a: Non-DRX case: 800 ms; DRX case: 5 DRX cycles. (Qualcomm P4)
  + Option 2b: Non-DRX case: 800 ms for NRS based measurement and 1600 ms for NSSS based measurement; DRX case: 5 DRX cycles. (Ericsson P7)
  + Option 3: 800 ms and for scenarios B, D, a single available time period for measurement shall be at least 400 ms, and the maximum interval between two available time periods for measurement on the cell shall be less than 5 seconds. (Huawei P3)
* Recommended WF
  + TBA

**Issue 1-4-2: Time for cell measurement in enhanced coverage**

* Proposals
  + Option 1: The minimum length of a measurement occasion can be 21ms. In some scenarios it can be 6ms for Frame structure type 1 and 7ms for Frame structure type 2. Several measurement occasions might be needed for scenarios B,D and E (ZTE P6 P7)
  + Option 2a: Non-DRX case: 1600 ms; DRX case: 5 DRX cycles. (Qualcomm P4)
  + Option 2b: Non-DRX case: 1600 ms for NRS based measurement and 1600 ms for NSSS based measurement; DRX case: 5 DRX cycles. (Ericsson P8)
  + Option 3: Focus on neighbour cell measurement before RLF in normal coverage and provide the observations to RAN2 in the LS reply. (Huawei O3 and P4)
* Recommended WF
  + TBA

**Companies views’ collection for 1st round for Sub-topic 1-4 (Q4)**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-4-1**  **Issue 1-4-2** |
| ZTE | **Issue 1-4-1:** Prefer Option 1. Option 3 would have significant impact to scheduling and interruption would be large under connected mode. Will further check on other options.  **Issue 1-4-2:** Prefer Option 1. Will further check on other options. |
| Ericsson | **Issue 1-4-1**  We support option 2b because, unlike other options, it captures that the measurement delays are different for NRS based and NSSS based NRSRP measurements.  **Issue 1-4-2**  We support option 2b because, unlike other options, it captures that the measurement delays are different for NRS based and NSSS based NRSRP measurements. |
| Huawei | **Issue 1-4-1**  We prefer option 3. Some response please find in issue 1-2-1. In short, we should provide the time needed for neighbour cell measurement in a more straightforward way. The measurement time in terms of DRX is not suitable for NB-IoT inter-frequency as there is not specific gap.  **Issue 1-4-2:**  We propose 2000ms in our paper, but suggest to focus on the normal coverage. The benefits of neighbour cell measurement for a cell in enhanced coverage is quite limited and the measurement occasions may be wasted. |
| Nokia | **Issue 1-4-1:** Option 2b.  **Issue 1-4-2:** Option 3. We agree to focus on UE in normal coverage. |

### Sub-topic 1-5 Q5: For how long the NRSRP measurements can be considered as valid?

**Issue 1-5-1: Valid NRSRP measurement definition**

* Proposals
  + Option 1: Refer to the known cell definition (ZTE P8, Huawei P5, Qualcomm P5)
  + Option 2: A NRSRP measurement would be considered valid for a period of time equal to N times the measurement period, where N is TBD. (Qualcomm P5)
  + Option 3: Depends on many factors including UE mobility state (e.g. static or moving) and also on the intended use case. (Ericsson P9)
* Recommended WF
  + TBA

**Companies views’ collection for 1st round for Sub-topic 1-5 (Q5)**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-5-1** |
| ZTE | **Issue 1-5-1:** Option 1. No need for a separate definition. |
| Ericsson | **Issue 1-5-1**  There is no current requirement how long the measurements can be considered valid as the validity may depend on different factors such as UE mobility state, coverage level etc. Thus we don’t think RAN4 can provide any exact delays indicating the validity time for this question. |
| Huawei | **Issue 1-5-1:**  There is no need to have the definition of a valid NRSRP measurement, and we don't have such definition before. We believe Q3 and Q5 are all about when the cell could be considered as known when the searching time could be saved. Then we suggested to refer to Q3 directly and consider Q3 and Q5 together. |
| Nokia | **Issue 1-5-1:** Option 1 can serve as assumption for the purpose of later RRC re-establishment in this cell under the assumption that the UE is in normal coverage. |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents