3GPP RAN WG2 Meeting #130 R2-25xxxxx

Malta, Malta May 19th – 23rd, 2025

Agenda Item: 8.9.1

Source: Huawei, HiSilicon

Title: RRC open issues for IoT NTN

Document for: Discussion, Decision

# Introduction

The following document includes a list of open issues according to the following email discussion:

* [Post129bis][310][R19 IoT NTN] RRC CR (Huawei)

 Scope: discuss the running RRC CR and create list of open issues

 Intended outcome: Endorsed CR and list of open issues

 Deadline: long

**NOTE: This open issue list document mainly collects the critical issues that need to be solved in order to finalize the RRC running CR and the issues related to enhancements which are proposed by multiple companies. For other issues, it can be discussed based on individual company’s contribution. Meanwhile, in order to make the way forward easier, the proposed solutions are kept general and the details can be further discussed once there is consensus or majority support for one direction.**

Companies are invited to provide feedback on open issue list by: May 6th 10:00 UTC

# Remaining open issues for RRC

### Store and Forward Satellite operation

**Open issue RRC-1:****How to indicate the time information for the transition from normal mode to S&F mode.**

**Issue description:**

During the RAN2#129bis, the following agreements regarding the transition from normal mode to S&F mode was made:

* **We introduce an indication in system information for the normal mode to S&F mode transition, at least for NAS use. FFS on the details (e.g. whether we can link this to other existing information). The information on transition time for the normal mode to S&F mode transition is sent from AS to NAS, and we inform CT1 about this in the LS**

Since the details are still FFS, the time information for the transition from normal mode to S&F mode hasn’t been captured in the RRC running CR. Based on the contributions, the following options are proposed on how the time information is indicated:

**Option 1:** It is up to NW implementation to set the legacy t-Service as the transition time from normal mode to S&F mode.

**Option 2:** Introduce a new indication for the transition time from normal mode to S&F mode for the S&F UEs.

**Option 3:** Using the agreed time information in SIB31 for both directions of transition. UE determines which direction it is based on whether the S&F indication is present.

**Q1: Companies are invited to provide feedback regarding the above open issue and possible proposed resolution:**

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| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| Huawei, HiSilicon | Option 1 | 1. Option 1 gives the flexibility to allow legacy UEs to start measuring the neighbour cells before switching to the S&F mode **in case the NW thinks that legacy UE is not suitable to be served by S&F mode**, e.g., due to delay sensitive services or possible rejections by the CN when initiating NAS procedure in S&F mode. NW can also choose to set the t-Service to the stop serving time of S&F mode in case it wants serve the legacy UEs in S&F mode. However, in Option 2 and Option 3, since legacy UEs cannot recognize the newly introduced indication in Rel-19, the UEs cannot start measurement of the neighbour timely when the serving cell switches to the S&F mode. Requiring the NW to release all UEs to realize this will lead to signaling overhead.
2. Reuse of t-Service to indicate the stop of normal mode will not cause any issue as in legacy there is only normal mode and the stop of normal mode equals to the stop of serve time. Note that in legacy, for earth moving cell case, t-Service refers exactly to the time when feederlink becomes unavailable, which is the switching time from normal to S&F mode in Rel-19. So this is aligned with legacy behavior.
3. For the stop time of S&F mode, we can refer to a new indication or reuse the time indication in SIB31 agreed by RAN2.
 |
| vivo | Option 1 | We share a similar view with Huawei that the legacy T-service can be reused for the case where the cell changes from normal mode to S&F mode (i.e. the feeder link is not available). Additionally, for S&F UEs, they should still initiate measurements prior to the specified T-service. This is because the UE might have an opportunity to reselect to another regenerative cell. There is no harm in reusing the T-service based measurement.  |
| Qualcomm | Option 1 + S&F indication | Option 1 is the baseline.Now question is how AS layer knows t-Service needs to be forwarded to upper layer? As this can be present in non-S&F normal cell.The t-Service may be real cell stop time (e.g., feeder link switch, not lost).Therefore additional indication is needed as we are talking about the cell currently operating in normal mode. |
| Mediatek | Option 3 | We are not sure what option 1 really implies. We should NOT change legacy definition of t-Service and should NOT change legacy UE behavior on usage of legacy t-Service. For legacy UE, if the cell intend to reject the legacy UEs after switching to S&F mode, the legacy barring bit will be used. There is no need to define legacy UE behavior for the time information of switching to S&F mode. Option 1 is not suitable to the R19 S&F capable UE. For S&F capable UE, there is no needed to start measurement due to lose of feeder link. Therefore, an additional indication is always needed for Rel-19 S&F capable UE to differentiate the situation. Option 3 would be a simple solution. |
| Google | Option 3 | Agree with MediaTek that we should not change the usage of the legacy t-Service. Otherwise, the UE capable of the S&F operation could trigger the neighbor cell measurement and cell reselection too early, resulting in unnecessary UE power consumption. If option 1 means we also need to introduece a new t-Service for the Rel-19 UE capble of the S&F operation due to repurposing t-Service, we believe using option 3 instead would be a cleaner and simpler solution.Besides, option 1 may not lead legacy UEs to reselect another cell before the feederlink is gone, as legacy UEs may eventually reselect the same cell due to the perfect link quality of the service link.  |
| ZTE | Option 1 + indication of transition to S&F mode(Option 2) | (Case 1) In the case where satellites operating in normal mode are going to switch to S&F mode, it generally corresponds to that satellites move from an area with a ground station to an area without a ground station. We think **Option 1** is feasible and can be beneficial to both the legacy UEs and R19 UEs, but only in a certain sub-cases as below:* (Case 1-1) In a sub-scenario of continuous coverage scenario, the serving satellite typically is in S&F mode before it stops serving the areas. Meanwhile, neighboring satellites are likely in normal mode when they start to cover the area. If the network also can ensure at least one of neighbour satellites can provide coverage when the serving satellite transits from normal mode to S&F mode, a possible optimization for NW implementation is to set an earlier stop time for *t-Service* of the serving satellite, e.g., at the start time of S&F mode (also transition time from normal mode to S&F mode), allowing the UE to measure neighboring satellites early and find a normal neighbor satellite, e.g., before the serving satellite starts to work in S&F mode. As such optimization is still to set the legacy parameter, it can be beneficial to both legacy UEs and R19 UEs.
	+ Please note, only when the network can ensure at least one of neighbour satellites can provide coverage, the network can apply such optimized setting of legacy *t-Service*. Otherwise, to set legacy *t-Service* to an earlier stop time may cause unnecessary discontinuous coverage result.

But in other sub-cases, e.g., as following:* (Case 1-2) sub-scenario of continuous coverage scenario where the start time of all neighbour satelltes are later than the transition time from normal mode to S&F mode of serving satellite but earlier than the time of stopping coverage
* (Case 1-3) discontinuous coverage

to set the *t-Service* as the time when the serving satellite starts to transit to S&F mode may cause problems, e.g., the UE cannot find any neighbour satellites (Case 1-2) or stops the AS layer process too early (Case 1-3). Instead, the more suitable way is to follow legacy way, e.g., to still set the *t-Service* as the time when the serving satellite really stops serving the area.For (Case 1-2) and (Case 1-3), another new time information when the serving satellite starts to operate in S&F mode (e.g., **Option 2** based on agreement in RAN2#129bis, can call it *t-NtoSF*) would be useful, which can only be used by the R19 UE to facilitate R19 UE to stop some services at an earlier time point (even the coverage still exist). When this new time information *t-NtoSF* is provided, UE can forward it to upper layer. In any case, the process of *t-Service* can be as legacy and only *t-NtoSF* can be forwarded to upper layer. For (Case 1-1), *t-NtoSF* generallycan be absent. But for R19 UE, it can assume *t-NtoSF* = *t-Service* and also forward this deduced *t-NtoSF* to upper layer.We don’t understand how the **Option 3** can work? RAN2 already agree to introduce a new UTC parameter, e.g., *t-SFtoN*, we think it needs to have its clear definition. If we agree to introduce another new para *t-NtoSF*, we don’t know how to express *t-NtoSF* by making use of *t-SFtoN*? So we think a separate *t-NtoSF* is still needed. But yes, for reduing signaling overhead, we think instead of providing another UTC parameter, a duration of Normal mode can be provided, the UE can deduce *t-NtoSF* by that:***t-NtoSF* = *t-SFtoN* + a duration of Normal mode.** |

**RRC-2: Whether to introduce additional assistance information for the neighbour cells, e.g., the operation mode and/or mode transmission time.**

**Issue description:**

Some companies believe it is beneficial to let the UE know about the operation mode/ mode transmission time of the upcoming neighbour cells.

**Q2: Companies are invited to provide feedback regarding the above open issue:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **operation mode** | **mode transmission time** | **Other comments** |
| Huawei, HiSilicon | Yes | No | **Operation mode**:One possible benefit is that if one satellite performs S&F operation but is not in the provided NAS list, the UE doesn’t have to try to access this satellite since there is no UE context on this satellite. Otherwise, it will be provided in the NAS list. UE power can be saved in this case.**Mode transmission time:**UE only needs to know the operation mode after the satellites covers this area and once the satellites becomes the serving satellite, UE will know the mode transmission time from system information.  |
| vivo | No | No | For an S&F UE, the operation mode of the neighboring cell, whether it is in S&F mode or normal mode, has no impact on it. This is because the UE can keep communication whether on a regenerative cell or an S&F cell. No further enhancement is needed. In the case of a legacy UE, when the neighboring cell is in S&F mode and the UE attempts to select that cell, the UE can determine that the cell is barred by referring to the S&F indication within the SIB1. Subsequently, the UE can initiate another reselection process until a cell operating in the normal mode is chosen. Therefore, even if there is no information regarding the operation mode or the operation mode transition time provided within the SIB1, no critical issues are anticipated. |
| Qualcomm | Yes | May be | These information is useful depending on the SI message size. |
| Mediatek | No | No | Agree with vivo |
| Google | Yes | No | A list of satellites operating in the normal mode (or the other way around) could be beneficial for cell reselection evaluation.  |
| ZTE | May be | Yes | (Case 2) In the case where satellites operating in S&F mode are going to switch to Normal mode, it generally corresponds to that satellites move from an area without a ground station to an area with a ground station. In this case, the serving satellite typically is in Normal mode before it stops serving the areas. Meanwhile, neighboring satellites are likely in S&F mode when they start to cover the area. Therefore, the connection to serving satellite can be maintained as much as possible. The stop time of serving satellite needs to remain as per legacy settings, e.g., to set as the actual time point when coverage is lost. * (Case 2-1) At the same time, since the neighbor satellites generally have no connection to ground station when they start to cover the area, a possible enhancement for NW implementation is to set a later time for the start time of neighbor satellites in SIB33, e.g., to set *t-ServiceStartNeigh* as transition time from S&F mode to Normal mode, allowing the UE to camp neighboring satellites a bit late till it can work normally.

However, in another sub-case, e.g., as below:* (Case 2-2) if the transition time from S&F mode to Normal mode of neighbor satellites is too late, e.g., later than the stop time of serving satellite, to set the start time of neighbor satellite as the transition time from S&F mode to Normal mode would be unsuitable, e.g., too late and may cause unnecessary discontinuous coverage result. For this sub-case, the more suitable process is still to follow legacy setting way, e.g., the *t-ServiceStartNeigh* is set as the time when the neighbor satellites really start cover the area, even they may work in S&F mode.
	+ In above scenario, we think a new time information when a neighbor satellite will transit from S&F operation mode to Normal mode, e.g., *t-SFtoN-Neigh* for each neighbor satellite in SIB33(-NB) would be useful for R19 UE to facilitate R19 UE to determine more suitable timing for measurement and reselection to a neighbor satellite. Only operation mode of neighbor satellite may be not sufficient.
 |

**Please ignore the following RRC-3 as explaned in the bubble comments:**

**RRC-3: Whether to prioritize frequency(ies)/cell(s) corresponding to the satellite(s) indicated in the MME-configured satellite list during cell reselection procedure.**

**Issue description:**

During the RAN2#129bis, the above issue was discussed but no consensus was reached:

* **Come back in the next meeting (the proponents could show the possible spec impact if we decide to go in this direction)**

Since this is an FFS issue and some proposed solutions may have impact to RRC spec, it is beneficial to collect more views from companies.

It was proposed that UE may prioritize frequency(ies)/cell(s) corresponding to the satellite(s) indicated in the MME-configured satellite list and in case of that, a frequency list and/or cell list associated with each satellite ID (indicated by the MME) are provided to the UE in system information.

**Q3: Companies are invited to provide feedback on whether a frequency list and/or cell list associated with each satellite ID (indicated by the MME) are provided to the UE in system information:**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No?** | **Other comments** |
| Huawei, HiSilicon | See comments | This may depend on the following two aspects:1. Whether there is a good way for the UE to prioritize the frequency related to the satellite indicated by the MME without affecting the reselection to the satellite with normal operation and the reselection to the TN cell.
2. Whether the legacy linkage between satellite ID and frequency is sufficient
 |
| vivo | No | The satellite ID within the SIB is not globally unique. Instead, it is only designed to take into account the satellites in the vicinity of the current serving cell. In contrast, the satellite ID in the S&F monitoring list is globally unique. This is because the S&F monitoring list needs to encompass satellites that may move into the coverage area of the UE in the future. Additionally, within the S&F monitoring list, there exists only a satellite index. As a result, this gives rise to ambiguity for the UE when it comes to determining which ephemeris information is relevant. Moreover, the association between the satellite ID provided in the S&F monitoring list and the frequency or cell might not be adequate. It becomes impossible to assign priorities to the frequency(ies) and cell(s) that correspond to the satellite(s) indicated in the satellite list configured by the MME.We suggest leaving this matter to the UE implementation as proposed by SA2. |
| CATT | See comments (Not an RRC open issue) | We don't think this issue is an RRC open issue, so it shouldn't be discussed here:* This issues is mainly related to a feature for cell reselection enhancement, so it mainly involves in potential impacts on IDLE mode procedure in TS 38.304. RRC configuration aspect is only what would result from this feature if agreed. It is the necessity of this IDLE mode feature itself that should be first concluded, not the RRC configuration in system information.
* As per chairlady's guideline on open issue list handling, only the simple/straightforward issues should be discussed directly in the open issue list discussion, with easy proposals from the Rapp and collection of companies' views. However, this issue, per the discucssion in the last meeting, does not belong to this category: what is still unclear includes satellite ID aspects, potential Spec impact to cell reselection procdure and why current IDLE mode procedure leaves no room for UE implementation. These all need proponent contribution to justify.

To this end, we hope the RRC Rapp can take into account the above situation, and leave this issue to further discussion based on company contribution in the next meeting, instead of trying to conclude it here with insufficient discussion. (At least) We are going to bring contributions to address above issues in detail in Malta.  |
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**RRC-4: Whether/how to reduce the paging monitoring for an S&F UE to save power consumption.**

**Issue description:**

Some companies believe it is beneficial to let the UE know whether there will be any paging expected from one satellite.

**Q4: Companies are invited to provide feedback on whether to reduce the paging monitoring for an S&F UE to save power consumption:**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Other comments** |
| Huawei, HiSilicon | Yes | If there is no paging expected, UE can skip paging monitoring the whole time during which the satellite covers this area and UE will only access in case there is uplink service. This would be very beneficial for the power saving of the IoT UEs.  |
| vivo | No | We can understand that following its release from the previous S&F cell, the UE might camp on a cell that is not assigned to serve this particular UE. For instance, the cell might not be operating on the satellite indicated in the MME list, and in such a case, there will be no paging activities for this UE at all. To carry out certain optimizations, it is likely necessary to involve SA2 and RAN3 for input before RAN2 considers potential solutions. Given the time limitations in R19 and the existence of other crucial unresolved issues, it is prudent not to introduce any additional new optimizations for paging. |
| Qualcomm | No | We are not clear why this is being discussed.Simply NAS provides the list of satellite and wait timer.We think this issue has already been addressed with wait timer. Its because UE can go sleep and wakeup after the wait timer to see the satellite. Why you think we need to discuss paging monitoring while UE is sleeping, how is it possible? |
| Mediatek | No | Agree with vivo. |
| Google | No | Agree with vivo  |
| ZTE | No | We understand NAS wait timer may be not so relevant to Paging as it may be mainly for control on attach procedure. But we also agree with vivo that RAN2 has no enough time in R19 to discuss paging optimization. Any Paging optimization needs the consistence between UE and network that may need involvement of RAN3 and SA2.  |

### UL capacity enhancement

For this sub-topic, the main impact to RRC is the resource configuration signalling design which needs to wait for RAN1 reply. Also, to avoid the duplicated discussion with MAC open issue list, no open issue is listed here for now.

### PWS support for NB-IoT

**RRC-5: Whether to allow skipping reading SIB1-NB to shorten the latency of PWS acquisition.**

**Issue description:**

During RAN2#128, the following FFS was left:

* **We will extend the existing ETWS/CMAS notification RRC procedures for eMTC to NB-IoT. FFS if SIB1-NB acquisition is needed**

Some companies believe it is beneficial to allow the UE to skipping reading SIB1-NB to shorten the latency of PWS acquisition.

**Q5: Companies are invited to provide feedback on whether to allow the UE to skipping reading SIB1-NB to shorten the latency of PWS acquisition:**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Other comments** |
| Huawei, HiSilicon | Yes | In order to satisfy the latency requirement of PWS delivery, allowing the UE to skip reading SIB1-NB is beneficial in case the UE has stored the scheduling information of PWS SIBs. |
| vivo | Yes | Enabling UE to skip the SIB1-NB acquisition before acquiring the PWS is beneficial and feasible.Specificall, this can be enabled via the implementation just like what NW implemented for SIB31, i.e., NW provide the PWS scheduling information within SIB1-NB even though there is no PWS notification.Allowing the User Equipment to bypass the acquisition of SIB1-NB prior to obtaining the PWS information is both advantageous and practicable. Specifically, this functionality can be achieved through an implementation approach similar to what the network has done for SIB31. That is, the network should furnish the PWS scheduling information within SIB1-NB, even in the absence of an actual PWS notification.

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| --- |
| NOTE 3: When acquiring SIB31(-NB) in RRC\_CONNECTED, UE may assume that the scheduling is unchanged. |

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| Qualcomm | Yes | We agree it is beneficial. |
| MediaTek | No | We don’t really think this is an essential issue to be addressed. According to the WID objective, we should “re-using the LTE mechanisms”. It is not practical to have pre-configured PWS as the network has to know the size of PWS to do so. It is also not clear how UE know the scheduling info in SIB1-NB is still valid when receiving PWS paging indication. Considering the limited remaining time in this WID, we should not have this enhancement. |
| Google | Maybe | The reason why the existing ETWS/CMAS notification procedure forces UEs to check SIB1 is because NW does not provide the ETWS/CMAS scheduling information before the ETWS/CMAS notification. If NW can provide the ETWS/CMAS scheduling information earlier, UE can simply rely on the legacy SI change notification procedure to determine whether to check SIB1 or not.  |
| ZTE | No | Agree with MediaTek it is not practical to have pre-configured PWS scheduling info as the network has NO idea about the size of PWS. Moreover, even assuming that kind of fixed scheduling configuration can be provided, considering PWS notification is rare case, to continuously provide such scheduling information when there is no need for PWS notification is a bad idea. |

**RRC-6: Whether to allow UE to receive and assemble PWS segments from different cells during mobility.**

**Issue description:**

During re-selection from the source cell to the target cell, UE may already have received some of the PWS segments from the source cell. Then the issue is after re-selection, whether UE can keep the received PWS segments from the source cell and assemble them with the PWS segments received from the target cell, or the UE should always discard the old segments from the source cell.

**Q6: Companies are invited to provide feedback on whether to allow UE to receive and assemble PWS segments from different cells during mobility:**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Other comments** |
| Huawei, HiSilicon | Yes | This is beneficial to avoid extra latency of receiving PWS messages during mobility. Otherwise, since UE may miss some segments from the target cell after the re-selection, it will need to wait for the next SI period to be able to assemble all the segments. So, it is better to allow UE to keep the segments from the source cell if the source cell and the target cell belongs to the same PWS area. |
| vivo | No | Allowing the UE to receive and assemble PWS segments from different cells could very likely entail the involvement of other working groups. In particular, coordination among eNBs is of utmost importance. Such coordination is indispensable for ensuring that there is a uniform and unvarying association between the segment ID and the content of the PWS message. We think this aspect be first verified and discussed with RAN3. Given the time limitations in R19, we propose that we do not consider this optimization at the current stage. |
| Qualcomm | No | PWS content may change. So UE is supposed to discard after changing cell. |
| MediaTek | No | The case is rare. It can be up to UE implementation.  |
| Google | Yes | Agree the merits mentioned by HW. |
| ZTE | No | We have similar concern as vivo. The different eNBs likely have different segmetation rules for the PWS, so it’s impossible or maybe wrong for UE to assemble PWS segments from different cells. |

# Other identified open issues

Companies are invited to describe any other identified open issues not currently included within this document (**only essential issues or issues proposed by multiple companies will be listed in the conclusion part**)

|  |  |
| --- | --- |
| **Company** | **Other identified open issues? (please describe)** |
| Qualcomm | Network PWS capability:UE is PWS capable but it keeps camping on cells that do not support PWS. This does not make sense for UE implementing the feature and not being able to take benefit of it.The UE should be allowed to monitor PWS in acceptable cell while it cannot find any suitable cell.The MIB-NB should indicate whether cell is PWS capable or not.S&F:Clarification that it is up to UE to find better normal mode cell at any time. |
| Mediatek | RAN2 agreed to support MT CB-Msg3-EDt, but how to support is unclear. The detail on the MT CB-Msg3-EDT procedure should be discussed based on companies’ contribution. |
| Qualcomm-2 | When normal mode cell changes to S&F mode, the RTT may change. Normal mode cell may be using ground eNB and serving legacy UEs. Tracking area may change. S&F indication/ NTN barring info may change. This will lead to SI change.We need to discuss how to update the system information as notifying UEs with paging is not efficient. |
| Google | As the likelihood of paging an irrelevant UE in an NTN cell for a PWS alert is very high, we think the PWS area information in coarse level (at most 2 bits are required) can be signaled together with a PWS indication in Paging-NB. The UE not within the area determined by the PWS area information can skip acquiring the system information relevant to the PWS, for saving energy. |
| ZTE | * Feedback to one of QC’s comments: It is preferable to introduce as few eNB capabilities as possible, not to mention the thought to consume precious bits in MIB-NB. Moreover, considering PWS provision is rare case, it still recommends that the UE generally camps on the cell with the best quality, rather than on a cell that supports PWS but does not offer the best quality.
* Feedback to Mediatek’s comment: we think MT CB-Msg3-EDT can try to leverage the parts of “Reception of the Paging message”(e.g., to store the mt-EDT indication), “setting of establishment cause/resumeCause” of MT-EDT procedure. Other parts would be same as MO CB-Msg3-EDT.
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|  |  |

# Conclusions

*<To be filled after companies have provided feedback to the proposed resolutions for simple issues only. Please include the number of supporting companies (e.g., 18/20]) in brackets within the proposal>*

The following proposals have been provided based on feedback to the above document:

[Proposals for easy agreement]

*<List all proposals with consensus and/or may be easily agreed based on Rapporteur’s opinion>*

[Proposals for discussion]

*<List all proposals which will likely require further online/offline discussion to resolve>*

# References

1. R2-2502983 Report from Break-out session on NR-NTN and IoT-NTN SessionChair (ZTE)