3GPP RAN WG2 Meeting #131 R2-250XXXX

Bengaluru, India, Aug 25th – 29th, 2025

Agenda Item: 8.9.2

Source: Nokia

Title: Remaining Open issues for Idle mode IoT-NTN Operation

Document for: Discussion, Decision

# Introduction

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

* [Post130][308][R19 IoT NTN] [TS 36.304 CR (Nokia)

 Scope: discuss the running TS 36.304 CR

 Intended outcome: Endorsed CR and list of remaining open issues

**Deadline:** Long

Companies are invited to provide feedback on open issue list by: TBD

# Remaining open issues for specification 36.304

**Open issue 1: Acceptable cell operation for NB-IoT (For PWS reception only)**

**Issue description: PWS Reception in acceptable cell for NB-IoT.**

In RAN2-130 meetings many companies interested in introducing support for PWS reception for NB-IoT out-side the cells of registered PLMN. The motivation to have this support is to enable reception of emergency messages at NB-IoT devices from any network broadcasting the PWS not limited to its registered network.

There are two options to introduce the support in the specification.

1. Introduce the support for ‘acceptable cell’ concept for NB-IOT in Rel-19. However if the acceptable cell type is supported it also impacts the cell selection process for the NB-IoT devices. For this option further proposals /questions provided in open issue 1A.
2. Alternative option is to allow the UE only to monitor for PWS related system information outside the suitable cells cell without any other procedures related to camping and monitoring other SIBs.

Companies are invited to provide their views on introducing PWS reception for NB-IoT in acceptable cell. Indicate the prefered options from the above. If you have alternative solutions ,please indicate the same.

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| **Company** | **Preferred Option** | **Comments** |
| Mediatek | Option 1 | If we want to support this feature, we should use better model (i.e. reuse accetable cell concept). Option 2 is a little unclear to us on how to specify the UE behavior. Selection for an “acceptable” cell for PWS reception is anyway required. |
| CATT | Comments | Option 1 introduces significant spec impact. If there is really a need to support this feature, it is better to introduce acceptable cell concept for NB-IoT when both emergency call and PWS are supported.We currently tend to support NB-IoT receiving PWS in a non-acceptable cell way. However, it is unclear how option 2 works if the UE is not camped on such cells. More clarification is needed before going towards this way. In summary, since August is the last meeting of Rel-19, detailed and clear-enough solution need be proposed in order to support such an enhancement for NB-IoT in this Release. Otherwise, we don't think any enhancements in this direction can be supported in Rel-19.  |
| Ericsson | Option 1 | Provided emergency calls will be supported in Rel-20, we prefer to adopt the concept of acceptable cell already now. A note can be included to clarify this is only for NTN and PWS as of Rel-19. |
| vivo | Option 1 | We suggest reusing the legacy concept for NB-IoT NTN. |
| Google | Option 1 | We share the same view as Ericsson on this.  |
| Apple | Option 1 | Option 1 seems more straightforward. |
| Qualcomm | Option 2 | We should try to do it in scope of RAN2 (i.e., without NAS impact) and without much specification impact. We could just leave it to UE that while being in any cell selection state. We can clarify that UE supporting PWS may camp on an acceptable cell of any PLMN to monitor PWS.  |
| ZTE | Option 1 | Similar view as above to try to reuse the legacy scheme. |

**Open Issue 1A:**

Following are the specification changes related to acceptable cell in TS36.304.

1. Acceptable cell definition :

An "acceptable cell" is a cell on which the UE may camp to obtain limited service (originate emergency calls and receive ETWS and CMAS notifications), and it is not applicable to RRC\_INACTIVE state.

**Proposal 1:** As emergency calls not supported in Rel-19 we also change the definition for NB-IoT in this release to exclude the emergency call in the definition.

1. Section 5.2.7 includes UE behavior on cell selection on return to RRC-IDLE considering acceptable cell for camping.

**Question 1**: Companies to comment on Whether this cell selection changes needed for NB-IoT PWS Reception.

1. Section 5.2.8 Indicates any cell selection state support for camping to acceptable cell

**Question 2:** Companies to comment whether the NB-IoT need to support this functionality for PWS reception.

Companies are invited to provide their views on the above proposals /questions related to specification impact if acceptable cell category is considered for NB-IoT for PWS.

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| **Company** | **P1/** | **Q1/Q2** |
| Medaitek | P1: No need to change the definition of acceptable cell. In current SPEC, it is already clear that NB-IoT UE does NOT support emergency call. Even if accetable cell includes the definition of emergency call, it should be clear that NB-IoT UE does not trigger emergency call. P2: Unclear. Which changes we are talking about ? Which part of 5.1.2 is impacted ? Any TP ?  | Q1: YesQ2: Yes |
| CATT | OK with the statement in P1. P2 is unclear. | If the "acceptable cell" concept is introduced for NB-IoT, the functionality in section 5.2.7 and 5.2.8 have to be supported. Otherwise, it is unclear under which conditions the NB-IoT UE start searching for acceptable cell.Additionally, “Figure 5.2.2-2: RRC\_IDLE Cell Selection and Reselection for NB-IoT” also needs to be updated. |
| Ericsson | P1: Agree with MTK. No need to change the definition. We just need to clarify the exception. | Q1/Q2: Yes.Agree with CATT that the figure should be updated (or merged with the previous one). |
| vivo | Fine with P1. | Yes to both Q1 and Q2. We also agree with CATT’s suggestion on Figure 5.2.2-2. |
| Google | Okay with P1 | Yes to both Q1 and Q2.  |
| Apple | Fine with P1 | Yes to both Q1 and Q2. Agree with CATT. |
| Qualcomm | P1: okQ1/2: see comments | To minimize the impact, we suggest just to add clarification in section 5.2.8a.5.2.8a Any Cell Selection state for NB-IoTIn this state, the UE shall attempt to find a suitable cell of any PLMN to camp on and searching first for a high quality cell, as defined in clause 5.1.2.2. The UE supporting PWS may attempt to find an acceptable cell of any PLMN to monitor PWS and regularly attempt to find a suitable cell of any PLMN.The UE, which is not camped on any cell, shall stay in this state until a suitable cell is found. |
| ZTE | P1: Agree with MTK it’s no need to change the definition of acceptable cell for NB-IoT. | Q1/Q2: Yes with update to Figure 5.2.2-2 (as mentioned by CATT) |

**Open issue 2: Working Assumption on SF mode operation indication for neighbour cells**

RAN2-130 has made the following working assumption.

Working Assumption:

1. In the neighbour cell list we introduce an indication whether the cell operates in S&F mode or not (FFS if we also include the transition time). This WA can only be confirmed if we converge on the corresponding UE behaviour.

The main FFS on this working assumption is related to whether UE behaviour related to cell reselection to be impacted with introduction of this parameter OR handling of this parameter should be left to UE implementation. Also for what cases /scenarios this information will be beneficial for UE ( For example whether the decision to select neighbour cell operating in SF mode is based on application layer trigger or status of pending paging reception for MO transmission).

Companies are invited to provide views on the scenarios where SF mode information in neighbour cell is beneficial and need to specify UE behaviour related to this parameter handling.

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| **Company** | **Scenario for usage of SF Mode of neighbour-cell** | **View on UE behaviour impact based on SF mode parameter of neighbour cell ( Impact to cell-reselection priority ..etc)** |
| MediaTek |  | If this new parameters are introduced, it should be up to UE implementation on how to handle the parameters. However, no significant benefit is foreseen by this new indication. We suggest not to do this in R19. |
| CATT | See right column | Rel-19 non-S&F capable UE may deprioritize the S&F cells during cell re-selection.Rel-19 S&F capable UE may prioritize the S&F cells according to its current operating mode or urgency level of signalling/data. |
| Ericsson |  | Provided the type of services in a S&F cell are clearly not the same as in a non-S&F cell, we understand that a UE may consider the status of neighbour cells in their reselection. For instance, even if a S&F cell has better RSRP, a UE would prefer to keep connected to a non-S&F cell. This could be either implemented by modifying the priority or the ranking in the reselection algorithm Without changes, the UE shall follow the specified algorithm and may end up in S&F cells even when there’s an alternative. |
| vivo |  | Same view as MediaTek.  |
| Google | When some neighbor cells are operating in S&F mode and some are not. | At least the Rel-19 UE not capable of the S&F operation can deprioritize the neighbor cells operating in S&F mode during cell reselection, if there are other neighbor cells operating in normal mode. |
| Apple |  | We are fine with such assistance info and prefer to have the transition time as well. Otherwise, the dynamic mode change of neighbor cell would lead to frequent SIB modification in serving cell.From UE point of view, it could be up to UE implementation how to handle it. |
| Qualcomm | See comment | Any indication would be useful for UE to prioritize the normal mode cell measurements, which can be left to UE. |
| ZTE | YesBut we prefer to introduce a new time info (e.g., *t-SFtoN-Neigh*) for neighbour satellites in SIB33 which is different from *t-ServiceStartNeigh* in SIB33.The legacy *t-ServiceStartNeigh* is the start time point of coverage of a neighbour satellite, but at this time point, the neighbour satellite may have no feeder link. Meanwhile, its *t-SFtoN-Neigh* may be later than *t-ServiceStartNeigh* and corresponds to the time point having feeder link and providing normal service. For R19 UE, by its implementation, it can delay measuring and accessing the neighbor satellite till this *t-SFtoN-Neigh* time point. | We tend to not touch the cell reselction based on priority, so we have no clear idea on how to use it if we just introduce a SF mode information for neighbour satellites.For our suggested *t-SFtoN-Neigh* information, besided the change in SIB33 siganling in TS 36.331, we can give a simple change to TS 36.304 as below example:

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| If *t-Service* is present in *SystemInformationBlockType3* of the serving cell, UE shall perform intra-frequency, inter-frequency or inter-RAT measurements, before the time *t-Service* regardless of the distance between the UE and serving cell reference location, and regardless whether the serving cell fulfils Srxlev> SIntraSearchP and Squal > SIntraSearchQ, or Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ. The exact time to start measurements before *t-Service* is up to UE implementation ~~and~~. The *t-ServiceStartNeigh* and *t-SFtoN-Neigh* if present in *SystemInformationBlockType33* may be used to decide on when to start measurements. UE shall perform measurements of higher priority inter-frequencies or inter-RAT frequencies regardless of the remaining service time of the serving cell. |

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Summary

**Open Issue 3 NAS configured list usage for idle mode operation of SF mode capable UE**

In RAN2-130, following FFS is marked in RAN2 agreement related to use of NAS configured Satellite List into discontinoues coverage procedure.

* FFS if we clarify in discontinuous coverage procedure in idle mode that the UE also takes into account the information about NAS configured S&F monitoring list.

For further discussion on this open issue, the latest 23.401 is provided here for reference.

**Usage of NAS Configured Satellite List from TS23.401 specificaiton**

Following is the text in TS23.401 related to NAS provided information related to SF mode operation and the relevant notes.[Section : 4.13.9]

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| For a UE which indicates support of Store and Forward Satellite operation and when an MME is operating in S&F Mode:- If the MME cannot complete a NAS procedure with the information currently available on the satellite e.g. when the MME does not have UE security context or, if the MME needs to retrieve UE-specific authentication vectors or subscription information from the ground network, it shall reject the NAS procedure. In this case, the MME shall include a reject cause indicating the NAS rejection is due to Store and Forward Satellite operation.- If the UE is rejected with a reject cause indicating it is due to S&F operation, the UE's EMM state shall remain unchanged.- The MME may provide to the UE a S&F Wait Timer, a S&F Monitoring List or both when accepting or rejecting a NAS procedure. The MME may provide S&F Monitoring List to the UE as part of detach procedure.NOTE 4: How the MME determines the S&F Wait Timer and S&F Monitoring List is up to MME implementation, e.g. based on feeder link (un)availability period, service link (un)availability period, UE power saving requirements, Communication Pattern parameters, UE location, UE mobility, etc.- When the S&F Wait Timer expires, the UE may perform a NAS procedure, which can be a subsequent NAS procedure or a reattempt of a NAS procedure previously rejected with a S&F reject cause, with a satellite of the same PLMN that is operating in S&F Mode.NOTE 5: When the S&F Wait Timer is running, the power consumption optimization behaviours, if any, are left for UE implementation e.g. whether to listen to paging or deactivate its Access Stratum functions. The S&F Monitoring List includes satellite(s) which belong to the same PLMN and indicates the satellite(s) that the UE may (re)attempt NAS procedures or receive MT data from.- The MME may indicate to the UE that it should delete any previously provided S&F Monitoring List for the current PLMN. When the S&F Monitoring List is deleted then the UE may use any satellite(s).NOTE 6: The S&F Wait Timer or S&F Monitoring List doesn't affect the UE when accessing an eNodeB that does not broadcast an indication of operating in S&F Mode.NOTE 7: How UE behaves when receiving the S&F Monitoring List is up to UE implementation. When a UE receives a S&F Monitoring List and the UE access a satellite that supports Store and Forward Satellite operation that is not on the S&F Monitoring List there is increased probability that it will not be able to complete the NAS procedure. The UE can continue to use the previously provided S&F Monitoring List, if the MME did not send one and the UE has previously been provided with one.- The MME may indicate to the UE an Estimated S&F UL Delivery Time in a NAS accept messages (i.e. Attach Accept, TAU Accept or Service Accept messages).NOTE 8: The Estimated S&F UL Delivery Time is an estimate of the time required to deliver the data or signalling sent by the UE to the ground. The Estimated S&F UL Delivery Time is associated with the satellite that provides it and how UE uses this information is left for UE implementation. |

According to the above reference text, the NAS Wait timer and NAS provided satellite list are used at UE for decision on resuming the NAS procedure when it is rejected from MME. This list can also be provided when attach and TAU procedure is accepted or during detach procedure also. The main purpose of this information is for the UE determining re-attempting the NAS procedure or receive MT data from. In the above NAS procedure description it is clear that use of the S&F Monitoring list is upto UE implementation.

**Observation 1: The NAS provided information related to SF operation ‘wait timer’ and ‘satellite list’ is for assisting the UE on its decision on NAS procedure or MT data reception. The usage is left to UE implementation as per TS23.401.**

NOTE 7 in the above specification text indicates possible delay in completing the NAS procedure if UE selects cell out of the NAS provided satellite list. However there is no clear direction in the above specification on impacts to AS operation related to cell selection or reselection.

**Observation 2: TS23.401 have mentioned the impact of NAS provided satellite list in many NOTEs. No specification text on usage of this information for AS operations.**

RAN2 has earlier sent LS to SA2 on the usage of the NAS Satellite list for access purpose and SA2 clarified already that this list does not impact to UE access related to cell operating in SF mode.

**Observation 3: SA2 has already confirmed that NAS provided list does not impact the access towards cell operating in SF mode.**

**Required steps for consideration of NAS configured Satellite List for AS operation**

In case if RAN2 agreed that NAS configured list is to be used for idle mode cell selection or reselection SA2/CT1 need to agree on providing this information to AS and it needs to be confirmed via LS from CT1. For this RAN2 need to send LS to request for the same. There could be changes in corresponding CT1 specifications.

**Observation 4: If the NAS list to be considered for AS operation the information exchange between NAS and AS needs to be agreed through LS coordination.**

Based on the above observations we request companies to provide views for the following questions.

1. Do companies see need for changing AS behaviour based on NAS configured Satellite-list considering the list is meant for NAS procedure continuity and MT reception as per TS23.401 (Additional usage of this parameter is left to UE implementation as per TS23.401). If yes, please elobarate on the scenario where such behaviour is beneficial for UE.
2. If AS usage of NAS satellite list is needed what is the expected changes in SA2/CT1 specification related to transfer of this information to AS. Also indicate whether we need LS to CT1 regarding this modified behaviour.

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| **Company** | **Views for Q1** | **Views for Q2** |
| Ericsson | No. This was already discussed in SA2 and and they reached the compromise that the list is informative. There is no incentive for the UE to communicate with satellites that are not in the list since they will not have its context. Thus, we do not need to mandate the behaviour in the specification. |  |
| vivo | Agree with Ericsson. | No. We should follow the current achievement (it is up to UE implementation how to use the satellite list. No RAN2 specs changed.) |
| Google | NOTE 7 in TS 24.301 (shown below) encourages UE to “access” a satellite in the S&F Monitoring List“When a UE receives a S&F Monitoring List and the UE access a satellite that supports Store and Forward Satellite operation that is not on the S&F Monitoring List **there is increased probability that it will not be able to complete the NAS procedure**”. We are wondering how this NOTE can be useful without impacting the AS cell seletion/reselection procedure, and therefore we see a need for changing the AS behavior.  | The only change that might be needed is to remove “How UE behaves when receiving the S&F Monitoring List is up to UE implementation” from NOTE 7 in TS 24.301. If eventually the impact of S&F Monitoring List on AS is confirmed by RAN2, an LS to SA2/CT1 can be helpful to specify (probably in NOTE 7) the transfer of this satellite list from NAS to AS. |
| CATT | Yes.***1) Prioritize satellites included in the NAS satellite list.*** Following the current cell (re)selection procedure, the UE shall (re)select to/camp on a cell that meets related RSRP/RSRQ conditions and the NW configured priority. This leaves no room for UE implementation to further consider the NAS satellite list as specified in SA2 Spec, resulting in increasing UE access failure as highlighted by SA2 (in case of an access attempt to a satellite not in the NAS satellite list).It is proposed to provide UE a “may” way on that, e.g., the UE may not consider the cell operating in S&F mode as a suitable cell for reselection, if it is not a cell provided by the satellites included in the NAS satellite list. TP refers to the Annex A of our contribution [R2-2504366] at the last meeting.***2) Relaxation on IDLE mode task, e.g., paging and cell (re)selection (from last meeting’s FFS)*** Another intention of SA2 to introduce this NAS satellite list is for UE power saving purpose [S2-2502513].

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| The satellite list is a tool which is used by the UE assist with saving power and determining which satellites to synchronise data with, and a useful tool for the network to guide the UEs allowing the network to save resources. |

We could simply add a NOTE under the discontinuous coverage procedure, such as:“NOTE: If S&F Monitoring list is configured by upper layers, and if the UE has determined that it is out of coverage of all the satellites in S&F Monitoring list, the UE may not need not perform any idle mode tasks related to NTN.”We will submit a contribution on these open issue. | “How UE behaves when receiving the S&F Monitoring List is up to UE implementation” in TS 24.301, already covers the transfer of the satellite list from NAS to AS.We also think if RAN2 confirm the AS behaviour based on NAS configured Satellite-list, an LS can be sent to SA2/CT1 to inform them. The SA2/CT1 specs change can be up to themselves. |
| Apple | Tend to no.1) We are not quite sure besides the satellite supporting store and forward, whether normal satellite will be deployed at the same time. According to SA2 LS ([R2-2501753](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2501753_S2-2502450.docx)), the list would only contain satellites supporting S&F. Or can we assume as long as the list is provisioned, the assumption is there is no normal satellites? Or UE does not need to care about normal satellites anymore even there are normal satellites?2) Another thing is as discussed last meeting, the satellite ID provisioned in NAS is a global satellite ID, but AS layer satellite ID is RAN specific ID (at least as of now). Extra assistance info for the correspondence between NAS satellite list and AS satellite ID may be needed.  |  |
| Qualcomm | Agree with Ericsson | Up to UE. No LS is needed. |
| ZTE | No.* Firstly, we don’t find the NOTE 7 mentioned by Google in “3GPP TS 24.301 V19.3.0 (2025-06)” (maybe removed from the latest version?). Most of the relevant NOTEs say as “*NOTE 12: How the UE uses the estimated S&F uplink delivery time duration and the S&F monitoring list is left for UE implementation*” or “*NOTE 4: How the UE uses the S&F monitoring list is left for UE implementation*”. So we think NAS give no clue on cell (de)prioritization to AS.
* Secondly, for cell camping, from AS layer perspective, we have the following thoughts:
	1. Firstly, according to the definition of S&F Monitoring List, we think this list gives assistance information for mainly NAS procedures (e.g., primarily providing the information needed for Attach), hence it should not have impacts on the AS layer processing, such as to find a suitable cell for camping. From the perspective of the AS layer, the UE camps on a cell not only to perform NAS procedures but also its own AS layer tasks (e.g., by obtaining neighbor cell information to perform cell reselection, receiving PWS services, etc.). Moreover, we are not sure whether the UE needs to perform the Attach procedure every time it accesses a new neighboring cell/satellite in S&F deployment? We do not think this is always necessary; therefore, we think there are scenarios where the UE only needs to access a satellite to camp, to access or to upload data (but no Attach), and in our understanding, such a satellite does not necessarily have to be one of the S&F Monitoring List.
	2. Logically speaking, if the UE does not camp on a certain cell/satellite, it cannot obtain the SIB31 from that cell, so how would the UE determine whether this cell/satellite belongs to S&F Monitoring List? Therefore, again, we still consider it unreasonable to include the consideration on S&F Monitoring List during the initial stage for finding suitable cell and camping, in AS layer spec.
	3. We are wondering whether it’s reasonable that after the UE camps on a satellite and obtains SIB31, it can send the serving cell's satellite ID to the NAS layer? Then if NAS determines that this satellite ID is not within the S&F Monitoring List, it may choose not to initiate NAS procedure, especially Attach procedure, if needed. The UE still can camp on this satellite as the NAS procedure except Attach and/or AS tasks still can be performed if the UE has already Attached previously. For this point, we may need AS->NAS interaction about forwarding satellite ID to upper layers on reception of SIB31. But considering that NAS layer has already mentioned leaving it to UE implementation, we feel this optimization might not be so necessary either.
* Thirdly, for paging reduction in S&F deployment scenario (please note, this is continuous coverage case), we can understand intention but think any paging reduction cannot be done by UE itself implementation and needs consistence between UE and NW (e.g., whether NW can know whether and when UE stops monitoring Paging?). So just a Note is not useful and risky. And we think we have no time to discuss this in R19.
 | We see no need for AS layer to acquire and make use of this S&F Monitoring List.On the contrary, we see kind of need to forword some information (e.g., Satellite ID in SIB31) from AS layer to NAS layer to [facilitate](http://www.dict.cn/facilitate) NAS layer better use S&F Monitoring List. But we also think such optimization is not so necessary and can be just left to UE implementation. |

# Other identified open issues

Companies are invited to describe any other identified open issues not currently included within this document

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| **Company** | **Other identified open issues? (please describe)** |
| Mediatek | If the acceptable cell is supported for NB-IoT, the Figure 5.2.2-2 should be impacted.  |
| CATT | **Open Issue 3:** The FFS part below for S&F specific IDLE mode enhancements should be included in the open issue list:* In a S&F network deployment which also exhibits discontinuous coverage, existing mechanisms to handle discontinuous coverage can be leveraged (e.g. satellite assistance information, UE not needing to perform idle mode tasks when the UE determines that is out of coverage, etc.). There is no need to modify existing discontinuous coverage features due to the addition of S&F Satellite operation. FFS if we clarify in discontinuous coverage procedure in idle mode that the UE also takes into account the information about NAS configured S&F monitoring list.

**Open Issue 4:** What/Whether impacts to cell reselection are needed due to the support of MME configured Satellite list:Proposal 1: Enhance the definition of suitable cell in 36.304 so that a UE may consider a detected cell as unsuitable and not treating it as a candidate for reselection, if the detected cell is handled by a satellite operating in S&F mode for which conditions (A) and/or (B) are met.[...]* Can come back to this

Note that the above two open issues related to MME-Configured Satellite list anyway need be concluded in the August meeting, due to the need indicated by the satellite companies and support from a number of companies. We disagree with ignoring/depriortising these issues which are clearly open issues left from previous meetings on the table.  |
| Ericsson | Paging in the context of S&F has not been discussed. Even if the network knows there’s no messages in the DL, the UE still has to wake up and listen to paging occasions. We consider this should be addressed to improve energy efficiency in S&F cells. |
| Apple | For paging in the context of S&F, we do have some sympathy on saving UE energy.  |
| Qualcomm | For monitoring PWS in an acceptable cell, the UE needs to be aware whether it is legacy NB-IoT cell or new cell supporting PWS feature. It is useless to monitor PWS in legacy NB-IoT cell. |

# Conclusions