**3GPP TSG RAN WG2 Meeting #120R2-22xxxxx**

**Toulouse, 14 - 18 Nov, 2022**

**Source:** Huawei, HiSilicon

**Title:** Report of [POST119bis][304][NES] TP on cell selection/reselection and SSB/SIB-less (Huawei)

**Agenda Item:** xxx

**WID/SID:** FS\_Netw\_Energy\_NR– Release 18

**Document for:** Discussion and decision

# 1 Introduction

This document is the report of the following discussion:

* [POST119bis][304][NES] TP on cell selection/reselection and SSB/SIB-less (Huawei)

- Provide TP for the solutions discussed as per agreements in these meeting for cell/selection reselection and SSB and SIB-less. The TP should be detailed enough describing the solutions and highlight some of the agreements/impacts.

- Identify remaining questions/details/RAN2 impacts that are required to be discussed for next meeting to conclude the SI. These will be from the rapporteur point of view and can be used for information purposes to guide contributions to next meeting

 Deadline: Friday Nov. 3rd, 2022 for TP

 Deadline: Friday Oct. 28th, 20220 for open issues (NOTE this is on top of inactive week, so discussions are not expected).

Please provide your comments on the open issue list before the end of Friday 2022-10-21 if it is not convenient for you to reply during the inactive period. The rapporteur will anyway collect all comments provided before Oct 28th.

Please provide your comments to the TP before Tuesday 2022-11-02 08:00 UTC. Thanks!

# 2 Draft TR

Based on below agreements RAN2 made online, we provide a draft TR on cell (reselection) and SSB/SIB-less in the [folder](https://www.3gpp.org/ftp/Email_Discussions/RAN2/%5BRAN2%23119bis-e%5D/%5BPOST119bis%5D%5B304%5D%5BNES%5D%20TP%20on%20cell%20selection%EF%BC%8Freselection%20and%20SSB%EF%BC%8FSIB-less%20%20%28Huawei%29).

**Agreements:**

1. There is a need to allow NES cells to prevent legacy UEs from camping. FFS the definition of NES cells.
2. Whether to bar legacy UEs is configurable by NES cells in Idle/Inactive mode and the network should be able to allow NES-capable UEs to camp on the NES cell. Options to bar UEs to be considered are 1) UseIntra/InterFreqExcludedCellList (FFS on the exact mechanism and spec impact) and 2) use cellBarred or cell reservation fields in MIB/SIB.
3. The network should be able to configure NES capable UEs to (de)prioritize NES cells. mechanism such as can be considered for both frequency and cell levels cell selection/reselection (de)prioritization. FFS on whether the existing mechanism is sufficient.
4. For SSB/SIB-less solution, RAN2 starts with multi-carrier case
5. RAN2 assumes that the SSB-less solution for inter-band CA in connected mode we can consider to use the intra-band CA mechanism as a baseline/starting point. FFS whether there are other impacts for RAN2 according to other WGs discussion
6. For SIB-less/SSB-less, capture the solutions in more details over the email discussion and clarify the definition on anchor cell. (e.g. 1) non-anchor NES cell doesn’t transmit SSB and SI 2) non-anchor cell doesn’t transmit SIB) FFS for paging in both mechanisms.

**Please do not insert / make comments in the TR document, which will be hard for Rapporteur to track and respond your comments.**

**Q1: Companies are invited to share their detailed comments on the draft TR for cell (re)selection in the table below.**

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| **Company** | **Detailed comments** | **Rapporteur response** |
| vivo | 1. For legacy intra-band CA, a UE can not only acquires time/frequency synchronization for the SCell based on SSB on SpCell, but also other SCell. This happens when the SCell transmitting reference SSB is the SpCell of other UEs.

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| ***absoluteFrequencySSB***......This is only supported in case the SCell for which the UE obtains the timing reference is in the same frequency band as the cell (i.e. the SpCell or the SCell, respectively) from which the UE obtains the timing reference...... |

Therefore, if we are to support UE the inter-band CA case, it seems that the reference SSB can also be on an inter-band SCell, which is missed in the draft TR. Although we think the maximum NES gain is achieved by transmitting SSB only on SpCell, but we suggest to add SCell in the 1st paragraph since the spec has already supported it:The SCell without SSB in intra-band CA is considered as baseline, i.e., for a serving cell without transmission of SS/PBCH blocks, a UE acquires time and frequency synchronization with the serving cell based on receptions of SS/PBCH blocks on the SpCell or the SCell, of the cell group for the serving cell. |  |
| Ericsson | * To maintain consistency with the agreements and to avoid specifying the details at this stage we suggest replacing “SIB1” with “SIB”, i.e., the following change:
	+ “Use the *cellBarred* or cell reservation fields in MIB/SIB”
* Regarding the FFS on the definition of NES cells, we think that whether there is a need to introduce the terminology “NES Cell” could be decided later after the NES techniques are better understood. We suggest using “a cell that uses a NES technique” in the meantime instead of “NES cell”. The reason is that the terminology “NES Cell” is quite general and unifies multiple NES techniques, which may not be appropriate in cases in which we need to distinguish between different NES techniques.
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| Vodafone | * I agree with Ericsson explanation, but my conclusion would be the opposite one. We should keep NES cell, NES capable UEs, etc. for now. Once it is more clear what all these techniques mean we can come back.
* “There is a need to allow NES cells to prevent legacy UEs from camping. NES cells should be able to configure whether to bar legacy UEs, and allow NES-capable UEs to camp on.” I think it has to be formulated in a different way: A mechanism to bar legacy UEs and allow NES capable UEs to camp on NES cell should be provided…

I am not sure what it means: “There is a need to allow”. Even today it is not forbidden, it is just not standardized. |  |
| Qualcomm | * Agree with Ericsson on the first point about not restricting the new “NES cell barring” field to SIB1. Just saying SIB is enough as how exactly it is done would be more of a stage 3 detail.
* Also agree with Ericsson on not introducing the “NES-cell” terminology. Since in the end, there would be many possible techniques of which a cell can deploy/not deploy so an “NES cell” would not have a clear definition. For the purposes of the context, it is a cell that uses some NES techniques that may sometimes require barring legacy UEs from access.
* “The NW should be able to configure NES-capable UEs to prioritize/de-prioritize NES cells” . We think we should hold off using prioritization or deprioritization language for cell selection. Prefer replacing this with “The NW should be able to configure NES-capable UEs on NES cell-(re)selection mechanism”. In our view, NES-cell selection to be studied can be more general in nature than copying exiting frequency prioritization, thus prefer to keep the language general.
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**Q2: Companies are invited to share their detailed comments on the draft TR for SIB-less and SIB-less in the table below.**

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| **Company** | **Detailed comments** | **Rapporteur response** |
| vivo | Question: Does the EN imply that paging may also be on the NES cell (i.e. non-anchor cell)?*Editor's note: FFS whether paging enhancements, e.g. no paging transmission, is applied to the scenarios where SSB and or SIB is not transmitted on the NES cells.* |  |
| Ericsson | * In Q2 above, we believe that the rapporteur intended to write “**TR for SSB-less and SIB-less**” instead of “**TR for SIB-less and SIB-less**”.
* Regarding SSB-less TR (i.e., Section 6.1.2 SCell without SSB in inter-band CA), it is not clear why only synchronization with PCell and PSCell is mentioned. We think that the synchronization can be obtained based on receptions of SS/PBCH blocks on any serving cell (i.e., the SpCell or the SCell) as already specified in the ***FrequencyInfoDL field description*** in 38.331. Therefore, in order to maintain the compatibility with the existing 38.331 specifications we propose the following change:
	+ “synchronization with the serving cell based on receptions of SS/PBCH blocks on the SpCell or the SCell of the cell group.”
* Regarding SIB-less TR (i.e., Section 6.1.3 NES Cell without SIB), we suggest replacing “NES Cell without SIB” with “Cell without SIB” in the title and the other relevant places in the document. We suggest this change because the terminology of “cell without SIB” does not necessarily have to be tied to the “NES cell”. Furthermore, in this way, the terminology will be more consistent with the terminology in Section 6.1.2 where we do not tie “Cell without SSB” with “NES cell”. Therefore, we propose the following changes:
	+ “6.1.3 Cell without SIB”
	+ ”necessary information for NES-capable UEs to access via an cell without SIB.”
	+ “An cell without SIB can omit the transmission of SIB”
	+ “the Random Access procedure is performed on the anchor cell, or one of the cell(s) without SIB.”
	+ “*Editor's note: FFS the details on how to support cell without SIB or without SSB and SIB.”*
	+ “*Editor's note: FFS whether paging enhancements, e.g. no paging transmission, is applied to the scenarios where SSB and or SIB is not transmitted on some of the serving cells for the purpose of NES.”*
* We also suggest reformulating the first sentence in Section 6.1.3.x as “from the perspective of the network” seems redundant. We therefore suggest the following change:
	+ “ Cell without SIB is only applicable in multi-carrier scenario, where there is an anchor cell and one or multiple cell(s) without SIB.”
* We suggest removing Sections 6.1.2.y and 6.1.3.y (i.e., “Assistance information from UE side”) since at the moment it seems that the assistance information is not relevant for SSB/SIB-less techniques. If we conclude differently in later stages, we can extend the TRs and add corresponding sections with relevant content if needed.
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| Vodafone | At this stage I would prefer to keep NES cells.To other parts of 6.1.3.x Higher layer procedureswhich need to be update in my view* Agree with E/// suggestion to remove “from the NW perspective”
* Anchor cell is a cell where NES-capable UE assumes SSB, system information and paging are transmitted. The system information transmitted by anchor cell also includes the necessary information for NES-capable UEs to access via an NES cell without SIB.

Not sure UE can assume. Probably we could formulate it in a following way:* Anchor cell is a cell where NES-capable UE receives SSB, system information and paging. The system information received over anchor cell includes all necessary information for NES-capable UE to access via NES cell without SIB.
* An NES cell without SIB ~~can~~ omits the transmission of SIB, or omits the transmission of both SSB and SIB.
* For NES-capable UEs in RRC\_IDLE/RRC\_INACTIVE, the Random Access procedure is either performed on an anchor cell, or on NES cell(s) without SIB, based on the system information transmitted by the anchor cell. When UEs in RRC\_IDLE/RRC\_INACTIVE performs Random Access on a cell and enters RRC\_CONNECTED, all subsequent data transmission occur on this cell.
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| Qualcomm | SCell without SSB:* Agree with Ericsson on not using “NES cell” terminology. Again, since many NES techniques are in discussion, we don’t have a specific definition. Just prefer describing what the cell does SSB-less, SIB-less, etc., since it is the case now that NES-cell can mean many things.
* RAN2 assumes that the SSB-less solution for inter-band CA in connected mode we can consider to use the intra-band CA mechanism as a baseline/starting point. FFS whether there are other impacts for RAN2 according to other WGs discussion
* Omit “Assistance information from UE side” section as it is not relevant right now.
* Prefer clarifying that the final support for those mechanisms will depend on the other WGs, not just RAN2 impacts.
* The wording make it seem like RAN2 needs to only study things if indicated by other WGs, however, even in it’s current state we thing the issues identified by Apple in the last email discussion should be captured by the TR, such as, RACH resource selection, timing of Pcell and Scell, RRM evaluation, RLM, etc. Currently, the wording assumes there is consensus that interband SSB is a simple extension of intraband which is not true, so companies’ RAN2 concerns should be captured if Interband SSB is to be included.

For Scell without SIB:* For similar reasons as mentioned about, NES-cell terminology should be avoided.
* “An NES cell without SIB can omit the transmission of SIB, or omit the transmission of both SSB and SIB.” This is still an open question in this email discussion so prefer to omit until opinions are discussed, same for the first editors not. Support is still FFS not just “how to support”
* Prefer to remove editors note on paging enhancements. This was not thoroughly discussed and no clear understanding on the SSB-less vs SIB-less vs SSB/SIB-less so there is no rush to agree that something needs to be done about paging.
* Also agree to remove “From perspective of the network” as it is redundant.
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# 3 Remaining issues

### 3.1 Cell selection and reselection

According to the discussion during this RAN2 meeting, the agreements and FFSes are captured as below:

1. There is a need to allow NES cells to prevent legacy UEs from camping. FFS the definition of NES cells.
2. Whether to bar legacy UEs is configurable by NES cells in Idle/Inactive mode and the network should be able to allow NES-capable UEs to camp on the NES cell. Options to bar UEs to be considered are 1) UseIntra/InterFreqExcludedCellList (FFS on the exact mechanism and spec impact) and 2) use cellBarred or cell reservation fields in MIB/SIB.
3. The network should be able to configure NES capable UEs to (de)prioritize NES cells. mechanism such as can be considered for both frequency and cell levels cell selection/reselection (de)prioritization. FFS on whether the existing mechanism is sufficient.

Rapporteur identifies the following issues to be further addressed at next RAN2 meeting accordingly:

1. General aspects:
	1. The definition of NES cells need to be further discussed, which may have impacts on the barring mechanism and access for NES-capable UES.
2. How to bar the legacy UEs, there are two options on the table:
	1. Use Intra/InterFreqExcludedCellList
	2. Use cellBarred or cell reservation fields in MIB/SIB

For both solutions, it needs to further discuss the detailed solutions and the potential specification impacts. For a), the gap with existing mechanism should be further clarified; for b), whether to use the existing IAB like solution, or NPN like solution, can also be discussed.

1. (de)prioritize NES cells by NES capable UEs
	1. Whether de-prioritization is sufficient for NES cells, or even prioritization of NES cells need to be supported
	2. The gap with existing mechanism, e.g. frequency priorities, cell offset to (de)prioritize cells
	3. Potential new mechanism description, and potential specification impacts

**Q3: Do companies agree to the above observation?**

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| **Company** | **Yes/No** | **Comments** |
| vivo | Yes |  |
| Ericsson | Yes, with comments | We suggest rephrasing “gap with existing mechanisms” to “applicability of existing mechanisms” as in the current wording it is not clear what the “gap” refers to.1. Whether there is a need to introduce the terminology “NES Cell” could be decided later after the NES techniques are better understood. We suggest using “a cell that uses a NES technique” in the meantime instead of “NES cell”. The reason is that the terminology “NES Cell” is quite general and unifies multiple NES techniques, which may not be appropriate in cases in which we need to distinguish between different NES techniques.
2. We agree to further study options a) and b), but our understanding is that this was already agreed upon during the meeting.
3. Ok to study.
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| Vodafone | Yes with comments | 1. NES cells are ok for now as we also have NES capable UEs, etc.
2. On 2 and 3 I agree with E///
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| Qualcomm | See comment | 1. Agree with Ericsson on number 1. At the moment, there is no need for a precise definition of “NES-cell” as it would be another discussion which NES solutions make the cell an NES-cell.
2. For the general aspects, that can have impacts on barring and impact of

both NES-capable UEs AND legacy/NES not-capable UEs.1. Barring legacy UEs: We think that the options should not be mutually exclusive as we see that both are needed. Otherwise, fine to explore solutions for legacy barring.
2. We would like to see 3. “Deprioritizing” cells language relaxed a bit. We think that the NES-capable UE can already prioritize/deprioritize frequencies using legacy mechanism. For cell-selection, the UE then chooses the best cell-quality We think that in this case, like HO, the UE should be able to apply some more flexible rules than rigid prioritization to balance a. Cell with good radio quality, if not the best. b. NW-wide energy savings considerations. Otherwise, cell “prioritization” can cause a single mobile UE to wake up several non-anchor booster cells unnecessarily and cell “deprioritization” means the UE can camp on a bad quality anchor cell with the presence of a non-anchor/booster cell already fully awakened to serve other UEs. To summarize, we prefer adding a bullet: “4. Mechanisms on incentivize and disincentivize NES-capable UEs from camping on cells according to their NES states”

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### 3.2 SSB-less and SIB-less

Regarding SSB-less, which is used for inter-band CA case by allowing SCell without transmitting SSB, the corresponding agreement is as below:

1. For SSB/SIB-less solution, RAN2 starts with multi-carrier case
2. RAN2 assumes that the SSB-less solution for inter-band CA in connected mode we can consider to use the intra-band CA mechanism as a baseline/starting point. FFS whether there are other impacts for RAN2 according to other WGs discussion

As discussed online, without more inputs from other WGs, there is no need to continue discussing this at next RAN2 meeting. It will only be triggered if other WGs clearly indicated there is a need for RAN2 to investigate more. Therefore for this part, the rapporteur would not set any questions for the moment, but may be updated according to the progress from other WGs.

Regarding SIB-less/SSB-less, the agreements are as below:

1. For SIB-less/SSB-less, capture the solutions in more details over the email discussion and clarify the definition on anchor cell. (e.g. 1) non-anchor NES cell doesn’t transmit SSB and SI 2) non-anchor cell doesn’t transmit SIB) FFS for paging in both mechanisms.

There are two directions on the table, one is for NES cells to omit transmission of both SSB and SIs, and the other is to maintain SSB transmission but not SIs.

From rapporteur’s observation, these two directions may have different energy saving gains, due to different amount of common signals transmission; on the other hand, different directions may be supported under different conditions, e.g. the UE needs to support CA etc. according to the agreement from SSB-less. In addition, quite a few companies mentioned NB-IoT solution of supporting multiple carrier. To ensure every company has the common understanding, it is better that in the next meeting, proponent companies could briefly describe the NB-IoT multi-carrier solution, and provide more detailed technical analysis on what is the common and different parts for SSB/SIB-less compared with NB-IoT solution.

Therefore, the rapporteur summarized the two directions as below with the aspects to be addressed summarized together:

1. The anchor cell transmit SIs for NES cells, and NES cells transmit neither SSBs nor SIs;
2. The anchor cell transmit SIs for NES cells, and NES cells transmit SSBs but not SIs.

Aspects to be addressed:

* the detailed solution and potential specification impacts for each direction;
* the benefits for energy saving and constraints for each direction;
* impact on the UE behaviour, e.g. whether the UE always camp on the anchor cell, or can also camp on the NES cells (this is rather dependent on specific directions), how the UE will determine which cell to perform RACH; the applicable RRC state, e.g. whether it only applies to idle mode, or also applies to connected mode;
* the gap with existing solutions, e.g. how much we can reuse from NB-IoT solution and what needs to be enhanced compared with NB-IoT

**Q4: Do companies agree to the above observation on SSB-less/SIB-less on the above two directions?**

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| **Company** | **Yes/No** | **Comments** |
| vivo | Yes |  |
| Ericsson | Yes | Ok to study the identified directions. Regarding the definition of “the non-anchor cell”, we think that this can be revisited later once it is clear which direction(s) we will continue to consider. In the meantime, we can be more descriptive and say “non-anchor cell that does not transmit SSBs and SIs” for direction 1, and “non-anchor cell that does not transmit SIs” for direction 2.We suggest rephrasing “gap with existing solutions” to “applicability of existing solutions” as in the current wording it is not clear what the “gap” refers to. |
| Vodafone | See comments | * the benefits for energy saving and constraints for each direction;

VF: Is that something RAN2 is going to provide or is it something we think will come out of RAN1?* impact on the UE behaviour, e.g. whether the UE always camp on the anchor cell, or can also camp on the NES cells (this is rather dependent on specific directions), how the UE will determine which cell to perform RACH; the applicable RRC state, e.g. whether it only applies to idle mode, or also applies to connected mode;

VF:“Do you means NES capable UEs”? The question to me is rather why the UE should be able to camp on NES cell?* the gap with existing solutions, e.g. how much we can reuse from NB-IoT solution and what needs to be enhanced compared with NB-IoT

VF:NB-IOT solution was designed not to save Network power, but rather to enable some capacity enhancements for NB-IOT and of course we should look on how it was designed, but not assume it can be copied 1 by 1 to this SI. |
| Qualcomm | No (support only the first direction) | The first solution can be studied, however, we think there is a lot of things that still need to be covered1. For the SSB/SIB-less conditions, we would like to confirm that the content of the SIB1 for both anchor and non-anchor cells is identical (BWP, freq. information, etc.). Hence this can only work under some conditions on the anchor and non-anchor cells. We would like to add those conditions that should apply to the solution for things to study as an additional bullets. “Conditions on the SSB/SIB content to apply this solution”.
2. According to the agreement of SSB-less, the UE must support CA for this solution to work. Thus, proponents need that to compare this solution to simple Scell activation solution and clarify the pros/cons. We would also like to add this: “Improvements and changes from current CA baseline solutions, if any.”
3. To follow up, we understand this solution to be a solution where the UE must perform RACH on the anchor cell, if this is not the case, we would like clarification on how the cell for RACH is chosen aside from describing the RACH process to the non-anchor cell? Again, since a UE doing that mandatorily supports CA by agreement, we would like to clarify what improvements, if any, this brings over the baseline. We would like to add the following bullet for things to clarify next meeting: “Details of RACH procedures on the anchor or non-anchor cells including changes from the CA baseline, if any”.

For the other branch of an anchor cell that transmit SSB but not SIB1, we do not support studying this solution. In our point of view, the proponents did not demonstrate any details about that solution other than very high-level views, so we would like to deprioritize this scenario since it has not been properly discussed. The proponents can provide contributions explaining the solution other than just mentioning that the non-anchor cell does not transmit SI. Our unaddressed concerns with this solution:1. Expected NES if any. In this case if SIB content is different this just means that the anchor cell transmits SIB1 on behalf of every non-anchor cell in its vicinity, likely, with higher power too, so it looks like we just changed the SIB1 transmitter to one that uses higher power. Unclear how this leads to NES savings.
2. The RACH procedure between the UE and the non-anchor cell is still unclear.
3. The synchronization and collocation requirements between anchor and non-anchor cells.
4. Motivation to introduce this solution rather than simply using the CA baseline or even the first solution.

To summarize, the second solution in our view remains lacks both sufficient detail and motivation to be seriously considered.  |
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In addition to the above, it is also an open question on how to handle paging. To study paging, the rapporteur understands the major question is whether paging can be omitted in the NES cell and only sends in the anchor cell, which can further omit transmission from NES cells. It is worth mentioning that if these two cells are already within one RNA, this seems already possible. The question should also be addressed that in such a scenario, how to justify whether the UE camps on an anchor cell or an NES cell.

The above discussion may result in a few combinations of different components, e.g. whether SSB-less is combined with SIB-less, whether paging enhancements is conditioned with SIB-less. From rapporteur’s observation, it would be good whether the most reasonable combination needs to be considered, otherwise this may result in too many fragmented sub-directions.

In summary, the aspects to be addressed include:

* detailed solution description, benefits and potential specification impact;
* impact on UE behaviour on cell camping;
* gap with existing solutions
* potential relation with SSB-less and/or SIB-less solutions

**Q5: Do companies agree to the above observation on aspects to be address for potential paging enhancements?**

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| **Company** | **Yes/No** | **Comments** |
| vivo | Yes | From the draft TR, it seems that the **possible cases for NES cell** include (since SSB/SIB/RA/Paging is always supported in anchor cell, we omit it for discussion):* Alt 1: SSB **can** be transmitted, paging **is not** supported on the NES cell; If the NES cell need not to transmit SSB (due to NW implementation), then it is same as Alt 2.
* Alt 2: SSB **is not** be transmitted, paging **is not** supported on the NES cell;
* Alt 3: SSB **can** be transmitted, paging **is** supported on the NES cell; If the NES cell need not to transmit SSB (due to NW implementation), then it is same as Alt 4.
* Alt 4: SSB **is not** be transmitted, paging **is** supported on the NES cell;

I’m not sure if I have listed all the alternatives. We agree with rapporteur that it would be good we reach a concensus on which sub-direction(s) to go for and then analyse the impacts. |
| Ericsson | Yes | It is ok to study how to handle paging in relation to SSB/SIB-less solutions. We think that paging enhancements are more conditioned with SSB-less than SIB-less solutions.  |
| Qualcomm  | No  | For the SIB-less solution, it is still unclear what is a non-anchor cell so discussing paging from the unspecified cell seems very premature and would just bring more questions than answers. In particular it is still unclear how the UE acquires synchronization and, in the case of, offloading the paging to the anchor cell, would the UE need to continuously synchronize with the anchor and non-anchor cell? This seems to already bring possibly limited energy savings at the cost of high UE power consumption. Also, we remark that earlier email discussion had already a solution about paging-less cell (Solution #8) which showed 10 No and 4 Yes due to the UE expected power consumption and unnecessary increasing complexity, lack of clear energy gains and the need to involve multiple WGs in such a study, so we prefer to omit Q5 and this section altogether.  |
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# 4 Conclusion

To be completed