3GPP TSG-RAN WG2 Meeting #117-e R2-220XXXX

Electronic Meeting, 21 February – 3 March, 2022

**Agenda item: 8.8.2**

**Source: CMCC**

**Title: Report for [AT117-e][241][Slicing]** **Closing slice-specific reselection open issues (CMCC)**

**WID/SID: FS\_NR\_slice**

**Document for: Discussion and Decision**

# Introduction

This document aims at address the remaining open issues for slice-specific cell reselection.

* [AT117-e][241][Slicing] Closing slice-specific reselection open issues (CMCC)

      Scope: Discuss and attempt to resolve remaining open issues for slice-specific cell reselection (as per previous open issue discussion). Can discuss further details of key aspects from [240] that require additional discussion.

      Intended outcome: Discussion report in [R2-2203650](file:///C:\Users\terhentt\Documents\Tdocs\RAN2\RAN2_117-e\R2-2203650.zip).

      Comment deadline: Thursday W1, 0900 UTC (for collecting views)

Rapporteur proposals: Thursday W1, 1200 UTC (proposed resolution of issues)

Document deadline: Friday W1, 0430 UTC (report, agreed CRs, final approved LS, etc.)

Rapporteur has provided suggested treatment for each open issue as identified in open issues list in R2-2202616.

* 1. **Simple issues, Company input into Pre117-e-offline**
  2. Company tdocs invited.
  3. CR rapporteur handled issue (CR rapporteur will propose resolution as input to next meeting).
  4. Other, e.g. immature area, reference to dependency, unclear status etc.

Since we already have a summary for slice-based cell reselection in R2-2203509, the open issues of slice-based cell reselection would be discussed based on the proposals in the summary. Considering that not all companies have contributions for each open issue, rapporteur suggests to confirm essential and simple proposals in this offline discussion. All company comments are welcome.

**Contact List**

|  |  |  |
| --- | --- | --- |
| Company | Name | Email |
| Qualcomm | Peng Cheng | chengp@qti.qualcomm.com |
| Lenovo, Motorola Mobility | Prateek Basu Mallick | Pmallick at lenovo dot com |
| Huawei, HiSilicon | Jun Chen | jun.chen@huawei.com |
| Samsung | Chadi Khirallah | [c.khirallah@samsung.com](mailto:c.khirallah@samsung.com) |
| Apple | Yuqin Chen | yuqin\_chen@apple.com |
|  |  |  |
|  |  |  |

# Discussion

## List of 38.304 open issues

### OI 3.1: Details for option A without formula

***OI 3.1: Option A without formula: Solution 4, all NAS-prioritised slices with frequency priorities as well as legacy frequency priorities are considered, without iteration, without formula***

Rapp’s note: OI 3.1 and OI 3.2 are the most important issues for this meeting so be suggested to have offline and online discussion.

Working assumption in RAN2#116bis-e:

* Working assumption: We go with proposal A without formula, e.g. as proposed by Samsung or Apple. Exact details to be worked out for the next meeting.

***Summary from R2-2203509:***

From the above proposals, 4 out of 16 companies (Intel, CATT, Samsung, Qualcomm) definitely propose to confirm the working assumption on option A without formula. 13/16 companies give the details for option A without formula although they don’t definitely propose to confirm WA. Only one company (Lenovo) propose to use Proposal B (Solution 4) for further work.

Hence, rapporteur suggests to follow the majority view to confirm WA firstly.

**(15/16) Cat-a-Proposal 1: RAN2 confirm the working assumption on option A without formula.**

**Q1.1: Do you agree the cat-a-proposal 1?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| **Qualcomm** | **Yes** |  |
| Lenovo, MotM | No | Since Option A without formular means “no iteration”, it leads to sub-optimal behaviour: e.g., a frequency will not be considered for a second highest priority slice if the reselection on said selected frequency does not work out for the highest priority slice. If there were just two (allowed) slices for a UE, **a slice based reselection will not be made even though a frequency supporting one of these is available**. |
| Huawei, HiSilicon | Yes |  |
| **Samsung** | **Yes** |  |
| Apple | Yes |  |

For details of option A without formula:

1. **The rules for slice specific frequency priority:**

Rapporteur try to summary some common rules from companies’ contributions.

* 1. Considering the slice/slice group priority provided by NAS, the frequencies that support higher priority slice/slice group have higher slice based frequency priority than the frequencies that support lower priority slice/slice group; (7 companies, Spreadtrum, Apple, CMCC, CATT, Huawei, ZTE, Ericsson)
  2. Among the frequencies supporting a slice/slice group with the same priority, the UE should follow the slice specific frequency priority received in SIB or RRCRelease (if configured); (9 companies, Spreadtrum, Apple, CMCC, Huawei, Samsung, QC, OPPO, ZTE, Ericsson)
  3. Among the frequencies supporting the same slice/slice group, the frequency not configured with slice specific reselection priority should be considered as lowest priority; (4 companies, Samsung, QC, OPPO, ZTE)
  4. The frequencies that support any slice/slice group have higher slice based frequency priority than the frequencies that support none of slice/slice group; (10 companies, Apple, CMCC, CATT, Huawei, LG, NEC, Samsung, QC, OPPO, Ericsson)
  5. For the frequencies that not support any slice/slice group, the UE should follow the legacy CellReselectionPriority received in SIB or RRCRelease; (8 companies, Apple, CMCC, Huawei, Nokia, Samsung, QC, OPPO, Ericsson)

There are some rules without consensus:

1. The same frequency can be sorted only one time or multiple times, in other words, whether a frequency can be checked only one time or multiple times in slice based cell reselection procedure.
   * 1. Only one time; (Samsung, QC, Ericsson)
     2. It can be multiple times; (Apple, CMCC, Huawei)
2. Among the frequencies supporting the same slice/slice group with same frequency priority, how to handle the frequency priority:
3. the frequency supporting maximum intended slices may be prioritized; (Apple, LG)
4. they are considered as equal priority; (Samsung, QC)
5. Up to UE implementation; (China Telecom)
6. **How to keep the frequency priority:**

4 companies (Apple, CMCC, Huawei, China Telecom) propose to generate a candidate frequency pool/list, but 4 companies (CATT, Samsung, QC, OPPO) proposes that it is up to UE implementation how the UE realises the rules (e.g. using an internal priority list or a Matrix).

Hence, the following proposal can be summarized to follow majority views:

**Cat-a-Proposal 2: The UE should determine the slice specific frequency priority according to the following rules:**

* 1. **Considering the slice/slice group priority provided by NAS, the frequencies that support higher priority slice/slice group have higher slice based frequency priority than the frequencies that support lower priority slice/slice group;**
  2. **Among the frequencies supporting a slice/slice group with the same priority, the UE should follow the slice specific frequency priority received in SIB or RRCRelease (if configured);**
  3. **Among the frequencies supporting the same slice/slice group, the frequency not configured with slice specific reselection priority should be considered as lowest priority;**
  4. **The frequencies that support any slice/slice group have higher slice based frequency priority than the frequencies that support none of slice/slice group;**
  5. **For the frequencies that not support any slice/slice group, the UE should follow the legacy CellReselectionPriority received in SIB or RRCRelease;**

**Q1.2: Do you agree the cat-a-proposal 2?**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Yes for which bullet** | **No for which bullet** | **Comments** |
| **Qualcomm** | **All** | **N/A** | **We think all above 5 rules are:**   * **Technically reasonable** * **Aligned with both Ericsson’s CR with formular and original option 4.** |
| Lenovo, MotM | a), b), d) and e) | c) -> needs clarification | First, we believe all slice/slice group mentioned in the rules are with respect to the slices of a particular UE (given from NAS to AS) => please confirm,  Second, is c) talking about a case where a frequency f0 supports slice x but there is no frequency priority signalled for the frequency f0 corresponding to slice x? |
| Huawei, HiSilicon | All |  |  |
| **Samsung** | **Yes to a), b), c), and d).**  **See comment for e)** |  | **Ok with a), b), c), and d).**  **Considering that the legacy cell reselection priority is CellReselectionPriority + CellReselectionSubPriority, we propose the following update to e):**  **e) For the frequencies that do not support any slice/slice group, the UE should follow the legacy cell reselection priority ~~CellReselectionPriority~~ received in SIB or RRCRelease;** |
| Apple | All |  | Samsung’s modification to e) is fine. |

**Cat-b-Proposal 3: The following rules can be discussed online:**

1. **Whether a frequency can be sorted only one time or multiple times, in other words, whether a frequency can be checked only one time or multiple times in slice based cell reselection procedure;**
2. **How to handle the frequency priority among the frequencies supporting the same slice/slice group with same frequency priority;**

**Option 1: the frequency supporting maximum intended slices may be prioritized;**

**Option 2: they are considered as equal priority;**

**Option 3: up to UE implementation;**

**Q1.3: For bullet a), do you think whether a frequency can be sorted only once or multiple times?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Once or multiple times** | **Comments** |
| **Qualcomm** | **Up to UE implementation**  **(See comments)** | **Our understanding is: as long as UE follows all 5 rules in Q1.2, we will have the same cell reselection outcome, irrespective of whether a frequency is sorted only once or multiple times (i.e., they are just different UE implementations).**  **An example to illustrate our understanding:**        slice1  slice2    Legacy (slice 1>slice 2 in NAS)          F1：6               2          1 (value is frequency priority value)          F2：3               6            2          F3：\*               5            3          F4:   \*               \*            4  **Alt-1: a frequency sorted only once:**   * Based on 5 rules, the UE will generate frequency priority order:{F1(6), F2(3), F3(5), F4(4)} * If best ranked cell supports slice 1, the UE will camp on F1. * If best ranked cell doesn’t support slice 1, the UE recalculates the frequency priority order with only slice 2 and legacy being considered. And {F2(6), F3(5), F1(2), F4(4)} will be generated.   **Alt-2: a frequency sorted multiple times:**   * Based on 5 rules, the UE will generate frequency priority order:{F1(6), F2(3), F2(6), F3(5), F1(2), F4(4)} * If best ranked cell supports slice 1, the UE will camp on F1. * If best ranked cell doesn’t support slice 1, the UE don’t need to recalculate the frequency priority order, but starts checking from 3rd item of {F1(6), F2(3), F2(6), F3(5), F1(2), F4(4)}, i.e., checking {F2(6), F3(5), F1(2), F4(4)}, which is same as Alt-1 |
| Lenovo, MotM | More than once when required | Practically this need not lead to re-measurement/ re-evaluation of the same frequency again. The measurements will be left to UE optimizations, and we define here only rules to ensure good slice reselection performance. |
| Huawei, HiSilicon | Multiple times | In our opinion, the UE behaviours are as below:   * Step 1: Based on 5 rules, the UE will generate frequency priority order:{F1(6), F2(3), F2(6), F3(5), F1(2), F4(4)} * Step 2:   + 2a: If the UE checks PCI list on F1&Slice1, and a cell meets the cell reselection criteria, the UE will camp on that cell   + 2b: If the UE checks PCI list on F2&Slice1, and a cell meets the cell reselection criteria, the UE will camp on that cell   + 2c, 2d, 2e, ….. (by the order of the frequency priority order in Step 1)   + Note: We think that there is no strict sequence between different steps (2a, 2b, 2c,…) because it depends on UE RRM measurements. In addition, if the UE finds that one cell meets 2a and one cell meets 2b, the UE should camp on the cell mentioned in 2a as the frequency has higher priority   Compared with Alt-2 in Qualcomm’s comments, our option allows that the UE can try F2&Slice2, while Alt-2 does not (the UE directly tries slice2 related frequencies). If the UE can find a suitable on F2&Slice1, it will still camp on a cell supporting Slice 1, so we think our option is better. |
| **Samsung** | **See Comments** | **In normal scenario, a frequency needs to be checked only once, according to its highest priority slice.**  **When the best cell in the frequency doesn’t support the highest priority slice available (for e.g. S), we have proposed that UE can recalculate priority according to the highest priority slice supported by best cell (for e.g. S1). So if there is no other frequency supporting S, UE may recheck the criteria based on S1 priority.**  **This can be done either by sorting multiple times or moving the frequency from one position in the list to another on priority change or moving the frequency from one cell in matrix to another on priority change etc.**  **The exact method can be chosen by UE implementation** |
| Apple | Multiple times | We share the exact same understanding as Huawei.  Though I admit UE implementation can somehow achieve similar outcome as explained by QC, I personally feel having the multiple copies allow UE to simplify the checking procedure. I mean UE can determine if the best ranked cell on one frequency support multiple slices at one time. |

**Q1.4: For bullet b), how to handle the frequency priority among the frequencies supporting the same slice/slice group with same frequency priority, which option do you prefer?**

**Option 1: the frequency supporting maximum intended slices may be prioritized;**

**Option 2: they are considered as equal priority;**

**Option 3: up to UE implementation;**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1/2/3** | **Comments** |
| **Qualcomm** | **Option 2 and option 3 (they are not mutual exclusive)** | **We think Option 2 and option 3 are aligned with legacy behaviour in 38.304. Please note below copy of NOTE3 from section 5.2.4.1 of TS 38.304:**  *NOTE 3: The prioritization among the frequencies which UE considers to be the highest priority frequency is left to UE implementation.* |
| Lenovo, MotM | 3 | No need to specify this. |
| Huawei, HiSilicon | Option 2 and option 3 | Share the similar views as Qualcomm. |
| **Samsung** | **Option 2** | **Option 2: they are considered as equal priority.** |
| Apple | Option 1 | We added one note to the TP, to make it soft enough. |

### OI 3.5: If the UE is configured with slice based dedicated priority, but the UE cannot find a suitable cell, whether and how to fallback to legacy cell reselection

***Summary from R2-2203509:***

From the above proposals, QC and CMCC suggest to reuse the legacy procedure (i.e., UE first enters any cell selection state and performs cell selection) when the UE cannot find a suitable cell if the UE is configured with slice based dedicated priority, and in legacy procedure, if priorities are provided in dedicated signalling, the UE shall ignore all the priorities provided in system information. Samsung and Huawei's view are similar. But Ericsson proposes that the UE shall use broadcasted legacy priorities if slice specific frequency priorities are sent in RRC release, but no legacy priorities are included.

Hence, rapporteur suggests to confirm the following understanding firstly:

**Cat-a-Proposal 8.1: RAN2 confirm that if the UE is configured with slice specific frequency priority via RRCRelease message, the UE shall ignore all the slice specific priorities provided in system information.**

**Q2.1: Do you agree cat-a-proposal 8.1?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| **Qualcomm** | **Yes** | **It is aligned with legacy principle when both dedicated signalling and common signalling are provided to the UE.**  **Please note that legacy (cell specific) frequency priority in SIB are still needed to be applied by the UE because some frequencies may not support any slice, i.e., rule e) in Q1.2.** |
| Lenovo, MotM | Yes | This is in line with *CellReselectionPriority*. |
| Huawei, HiSilicon | Yes | We think that if the UE receives dedicated slice reselection info via dedicated signaling and legacy reselection info via SIB, the UE should combine both information.  For example, based on Qualcomm’s scenario in Q1.3 (as below), If slice1 and slice2 info is received from dedicated siganlling and legacy info is received from SIB, the UE should try F1, F2, F3 and F4.        slice1  slice2    Legacy (slice 1>slice 2 in NAS)          F1：6               2          1 (value is frequency priority value)          F2：3               6            2          F3：\*               5            3          F4:   \*               \*            4 |
| **Samsung** | **Yes** |  |
| Apple | Yes |  |

If the proposal 8.1 is agreed, for OI 3.5, rapporteur suggests to follow majority view to reuse the legacy procedure.

**Cat-a-Proposal 8.2: The legacy procedure (i.e., UE first enters any cell selection state and performs cell selection) should be reused when the UE cannot find a suitable cell if the UE is configured with slice based dedicated priority.**

**Q2.2: Do you agree cat-a-proposal 8.2?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| **Qualcomm** | **Yes** | **It is legacy behaviour of TS 38.304** |
| Lenovo, MotM | Yes |  |
| Huawei, HiSilicon | Yes |  |
| **Samsung** | **Yes** |  |
| Apple | Yes |  |

### OI 3.6: Whether the inter-RAT frequency should be considered in slice-based cell reselection

***Summary from R2-2203509:***

From the above proposals, QC and CMCC propose that slice specific frequency priority values are not assigned to inter-RAT frequencies, 3 companies (Intel, Samsung, Ericsson) propose to consider the inter-RAT frequency at the bottom of list with legacy priority, and Spreadtrum proposes inter-RAT frequency should not be considered in slice-based cell reselection.

This issue is also related to OI 3.1, rapporteur suggests the following proposal:

**Cat-a-Proposal 9: Inter-RAT frequencies are not configured with slice specific frequency priority, but inter-RAT frequencies can be considered in slice based cell reselection based on legacy frequency priority** **after all frequencies that support any slice/slice group.**

**Q3: Do you agree cat-a-proposal 9?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| **Qualcomm** | **Yes** | **We think it is the most reasonable way forward: LTE frequencies can still be considered (for coverage) with lowest priority** |
| Lenovo, MotM | No | inter-RAT frequencies can’t be considered in slice based cell reselection. If the UE does not reselect to an NR cell on a higher priority and needs to find an Inter-RAT cell, like in legacy, the reselection to Inter-RAT frequency can be attempted. |
| Huawei, HiSilicon | Yes | Agree with Qualcomm |
| **Samsung** | **Yes** |  |
| Apple | Yes |  |

### OI 3.10: The slice info is slice or slice group specific

***Whether the slice specific cell reselection information provided by the network in SIB or RRCRelease message is slice or slice group specific***

***Summary from R2-2203509:***

For slice info provided in SIB, all companies (9/9) agree that it should be slice group specific.

For slice info provided in RRCRelease, 6/9 companies (Qualcomm, CATT, Huawei, Nokia, NEC, Ericsson) propose that it should be slice group specific, but 3/9 companies (Xiaomi, Spreadtrum, CMCC) propose that it can be either slice or slice group specific.

Hence, the following proposals are suggested to reach:

**(9/9) Cat-a-Proposal 12: The slice specific cell reselection information provided by the network in SIB is slice group specific.**

**Q4.1: Do you agree cat-a-proposal 12?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| **Qualcomm** | **Yes** |  |
| Lenovo, MotM | Yes |  |
| Huawei, HiSilicon | Yes |  |
| **Samsung** | **Yes** |  |
| Apple | Yes |  |

**Cat-b-Proposal 13: The slice specific cell reselection information provided by the network in RRCRelease is slice group specific (6/9) or it can be either slice specific or slice group specific (3/9).**

**Q4.2: which option do you prefer for slice specific cell reselection information provided by the network in RRCRelease?**

**Option 1: slice group specific.**

**Option 2: it can be either slice specific or slice group specific.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1 or 2** | **Comments** |
| **Qualcomm** | **Option 1** | **Otherwise, do we need to specify how the UE performs the mapping from slice level (in RRC release) to slice group level in AS layer?** |
| Lenovo, MotM | Option 2 | This allows flexibility |
| Huawei, HiSilicon | Option 1 |  |
| **Samsung** | **Option 1** | **The slice specific cell reselection information provided by the network in RRCRelease is slice group specific.** |
| Apple | Option 1 |  |

## List of RRC open issues

### OI 1.3: Whether to introduce a T320-like timer

***Whether to introduce a T320-like timer for slice-based cell reselection priorities in dedicated signalling, and if needed, there are two options:***

***Option 1: introduce a new T320-like timer which is independent from the current T320 timer.***

***Option 2: re-use the current T320 timer.***

Previous agreements in RAN2#113bis-e

Agreements

5 UE is only configured with either the existing dedicated priority configuration or the slice info in RRC Release.

***Summary from R2-2203509:***

From the above proposals, all companies (6/6) support to reuse the legacy T320 timer for slice specific frequency priority in RRCRelease.

There is a consensus to agree the following proposal:

**(6/6) Cat-a-Proposal 16: Reuse the legacy T320 timer for slice specific frequency priority in RRCRelease.**

**Q5: Do you agree cat-a-proposal 16?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| **Qualcomm** | **Yes** | **The IE in RRC release is UE dedicated. So, reusing legacy T320 is sufficient.** |
| Lenovo, MotM | Yes |  |
| Huawei, HiSIicon | Yes | For this meeting, we re-submit the report (as below) because it was not treated in the last RAN2 meeting.  R2-2203021 Report of [Post116-e][243][Slicing] Running NR RRC CR for RAN slicing (Huawei) Huawei discussion Rel-17 NR\_slice-Core  In the report, P1 is supported by most of companies, and it is aligned with cat-a-proposal 16.  **Proposal 1: legacy T320 timer is applied to slice specific frequency priority.** |
| **Samsung** | **Yes** |  |
| Apple | Yes |  |

### OI 1.9: Whether to support RAN sharing

***FFS RAN sharing for slice-based cell re-selection and slice-based RACH.***

***Summary from R2-2203509:***

4 Companies commented on OI 1.9.

3 companies support RAN sharing in R17. 1 company worry about the complexity and propose to limit that the different TAs in one cell should share the same slice group mapping relationship.

**(3/4) Cat-b-Proposal 18: RAN sharing can be supported for slice based cell reselection and RACH, but the complexity should be kept low. Details are FFS.**

**Q6: Do you agree cat-b-proposal 18?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| **Qualcomm** | **Yes, but** | **We prefer to make it clear that RAN sharing can be supported via NW implementation. Specifically:**   * **Slice specific frequency priorities are still RAN specific as legacy (i.e., not PLMN specific). And as legacy, operators sharing the same RAN should coordinate the values of frequency priorities broadcast in SIB.** * **cell ID, TAC and ranac are PLMN specific as legacy.** |
| Lenovo, MotM | Yes |  |
| Huawei, HiSIicon | Yes |  |
| **Samsung** | **Yes** |  |
| Apple | Yes |  |

# Summary

# References

1. R2-2202616 (is revised of R2-2201730) List of open issues for RAN slicing WI, CMCC
2. R2-2203509 Report for [Pre117-e][240][Slicing] Summary of slice-specific cell reselection (CMCC)