We’d like to specify clear UE behaviour and we don’t see any issue in Option 1. **3GPP TSG-RAN WG2 Meeting #117-e R2-220XXXX**

**Electronic Meeting, 21 February – 3 March, 2022**

**Source: Lenovo, Motorola Mobility**

**Title: Report for [AT117-e][244][Slicing] Frequency sorting and equal frequency priorities (Lenovo)**

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

**Document for: Discussion and Decision**

# Introduction

The following email discussion has been triggered on Friday, February 25, 2022:

* **[AT117-e][244][Slicing] Frequency sorting and equal frequency priorities (Lenovo)**

       Scope: Discuss how the frequency sorting and equal priority is handled and provide TPs for each alternative. Should discuss how each option works and provides consistent UE behaviour

       Intended outcome: Discussion report in [R2-2203782](https://apc01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.3gpp.org%2Fftp%2FTSG_RAN%2FWG2_RL2%2FTSGR2_117-e%2FDocs%2FR2-220XXXX.zip&data=04%7C01%7Cpmallick%40lenovo.com%7C2432aa88fb674aa0ec9608d9f83d30fe%7C5c7d0b28bdf8410caa934df372b16203%7C0%7C0%7C637813763969189669%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C2000&sdata=gbxL2KBlJzVpy3YAJlaFpb8%2FXG5quClg3fOjVfoUNUU%3D&reserved=0).

**Deadline: Deadline 4:**

**Deadline 4 (discussions for 2nd week Wed online):**

* **Comment deadline:** MondayW2, 1200 UTC (for collecting views)
* **Rapporteur proposals:** Tuesday W2, 1200 UTC (proposed resolution of issues)
* **Document deadline:** Tuesday W2, 1600 UTC (report or agreed CRs)

No extensions to this deadline for regular discussions. Discussions handling CRs may continue to short post-meeting email (based on chair decision).

# Discussion

### Agreements

RAN2 has reached following agreements:

|  |
| --- |
| * *1: RAN2 confirm the working assumption on option A without formula.*

***(prateek)**** *2: The UE should determine the frequency priority order according to the following rules:*

*a) 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;* *b) 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);* *c) Among the frequencies supporting the same slice/slice group, the frequency not configured with slice specific reselection priority should be considered as lower priority than other frequencies configured with slice specific reselection priority;**d) The frequencies that support any slice/slice group have higher slice based frequency priority than the frequencies that support none of slice/slice group;* *e) For the frequencies that do not support any slice/slice group, the UE should follow the legacy cell reselection priority received in SIB, FFS when only legacy priority received in RRCRelease;** *5: 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. FFS if we still apply the legacy cell reselection frequency priorities in SIB.*
* *6: 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 using any cell reselection priorities (including slice-based and legacy (non-slice based) priorities) if the UE is configured with slice based dedicated priority.*
* *7: Inter-RAT frequencies are not configured with slice specific frequency priority, but inter-RAT frequencies can be considered using legacy cell reselection frequency priority after all NR frequencies that support any slice/slice group.*
* *8: The slice specific cell reselection information provided by the network in SIB is slice group specific.*
* *10: Reuse the legacy T320 timer for slice specific frequency priority in RRCRelease.*
* *11: RAN sharing can be supported for slice based cell reselection and RACH by network implementation (e.g. dedicated priorities in RRCRelease). We don't define PLMN-specific reselection priorities or RACH configuration. FFS if we need something extra in RACH (may not be critical to WI completion).*
 |

Every solution would sort the list of frequencies at least once according to its methodology. The main question here is about a need for “re-sorting” at some point in time. If the need for re-sorting is left to UE implementation, some UEs may do the “re-sorting” and others may not. In certain scenarios this may differently influence the outcome of slice based reselection procedure.

**Q1: Does your company consider this as a central feature of current work (i.e., not just an optimization) and prefer a consistent and testable slice based reselection outcome/ performance?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/ No** | **Comments** |
| Nokia | Yes |  |
| Qualcomm | No (it is not essential to finalize RAN slicing WI) | We don’t think specifying “re-sorting” procedure is essential to complete this WI:* We are not sure what “re-sorting” means (and whether each company can have the aligned understanding by end of this meeting).
* In some candidate CR, there is no need for “re-sorting” (e.g. [R2-2202514](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2202514.zip) from Apple and BT, or [R2-2203071](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2203071.zip) from Nokia)
* In current TS 38.304, it is a continuous cell reselection procedure without any similar concept to mandate UE to “stop” and “re-sorting” frequency priority.

So, we suggest RAN2 can try to make progress in this meeting. But if no consensus is made by end of this meeting, we can conclude no need to specify it.  |
| OPPO | Yes | Otherwise, there will be different cell reselection outcomes for a certain case.  |
| CMCC | Prefer each frequency can appear multiple times in the sort pool, and no re-calculate is needed.Acceptable for each frequency only appears once in the sort pool, and re-calculate is needed. | We understand the **re-sorting means a frequency can appear multiple times in the sort pool**. And this issue is related to whether re-calculate is needed if the highest ranked cell doesn’t support the selected slice. RAN2 need to make a decision on this issue. The following options are proposed in previous discussion:* **Option 1: each frequency can appear multiple times in the sort pool, and no re-calculate is needed**.
* **Option 2: each frequency only appears once in the sort pool, and re-calculate is needed if the highest ranked cell doesn’t support the selected slice.**
* **Option 3: left to UE implementation**

We think that the candidate TP from Apple and BT (R2-2202514) *“A final single frequency ranked list to be considered by the UE is created from the concatenation of each individual slice or slice group frequency ranked list”* also means that a frequency can be sorted multiple times, same as option 1.In addition, we agree with rapporteur that if this is left to UE implementation, this may differently influence the outcome of slice based reselection procedure and has negative impacts on network control. In order to avoid UE camping behaviour on the frequency unpredictable, we should avoid option 3 (left to UE implementation).From our view, option 1 is simpler and straight forward. But if majority prefer option 2, we are also acceptable. |
| Spreadtrum | No for re-sorting | Share similar view with CMCC. In our understanding, the “re-sorting” may not the exact focus we discussed in last week. If a frequency can be sorted multiple times, it will be assigned different frequency priorities in first sort, rather than in the midway of reselection.In order to reduce UE complexity and guarantee predictable UE behaviour, we prefer to align with the legacy cell reselection procedure that the list of frequencies is sorted once.  |
| CATT | Yes | According to the analysis below, we think re-sorting means that when the highest ranked cell does not support higher priority slice, UE can re-consider the frequency for lower priority slices. If our understanding is correct. We agree that this is essential to specify whether allow re-sorting. This can lead to the different results. |
| Huawei, HiSilicon | No | We share the similar view with QC.Using the unclear wording of “re-sorting” may cause confusion for common understanding. If it means that when the highest ranked cell on the target frequency cannot support the prioritised slice, the priority of this frequency will be **changed**, we don’t see the need because the UE behaviour of cell reselection is continuous based on the list of sorted frequencies. And if it means that a frequency supporting multiple slices can be sorted **multiple times**, please see our comments in Q3. |
| Xiaomi | See comments | As there seems unaligned understanding on the “resort”, we prefer to have following options based on CMCC’s comments with minor modification* **Option 1: each frequency can appear multiple times in the sorted list, and no re-calculate is needed**.
* **Option 2: each frequency only appears once in the sorted list, and re-calculate is needed if the highest ranked cell doesn’t support the selected slice.**
* **Option 3: left to UE implementation**

We can note that current measurement procedure is performed based on reselection priority, thus a frequency can only be assigned with the only reselection priority, otherwise, the measurement can not be performed as the priority relative to the serving frequency can not be decided. Thus, 1. if the priority is used for only reselection procedure, both option1 and option2 is okay and it is can be left to UE implementation.
2. If the priority is used for both measurement and reselection procedure, option2 is preferred.
 |
| NEC | No  | Re-sorting will change the relative frequency priority comparing to serving frequency and consequently will impact the result of measurement rule and cell reselection criteria. It is complicate in our understanding. And re-sorting is necessary only because we want to consider secondary slice, which we think it is optimization since we never know next call of UE is for which slice. slice-based cell reselection should be best effort but not to be perfect. However, we are open to see a complete and clear TP to consider all slices with or without re-sorting |
| LG | No | We don’t consider re-sorting as a central feature of current work and agree with the Qualcomm’s comment, it is a continuous cell reselection procedure without any similar concept to mandate UE to “stop” and “re-sorting” frequency priority. |
| KDDI | Yes, but | In general, we want to have a consistent and testable slice based reselection outcome/ performance, but we also understand that completing the work within Release 17 is very challenging. So, we are fine to postpone the feature to the next release. |
| Samsung | See comments | Question has two parts1.Is resorting needed?2.Is consistent and testable slice based reselection outcome/performance needed?While we agree that a consistent/testable solution for slice based reselection outcome/performance is needed, we don’t think resorting is needed to ensure that. Agree with Qualcomm on the comments for resorting. |
| Intel | Yes, but may not be the main case | We think that re-sorting or re-arrangement of the frequency priority on the target frequency is needed in the case the slice group is not available in the target frequency. It can’t be left to UE implementation as this will not be testable.In our understanding, the cell list is only useful if this is supported. |
| BT | Yes | It is essential to ensure a predictable behaviour.Our understanding of re-sorting is that same frequency can appear more than once based on slice support and prioritization but how many times the UE does the measurements of each specific frequency can be left to UE implementation. |
| Apple | Yes | Same understanding as BT.Our understanding is it means that the same frequency can be considered multiple times with different priorities associated with different slices during cell reselection procedure. |
| Ericsson | Yes | Yes, some “re-ordering” (or whatever we call it) of the frequencies are needed, when the target cell (according to the PCI lists) does not support the slice group that is indicated for (other cells) on the frequency, but details can be left to UE impl. You can also express it that this frequency will get lower re-selection priority. |
| T-Mobile USA | Yes | Prefer this is not left for UE implementation. Also have concerns about this being non-testable. |

**Conclusion 1: Majority (11 out of 16 companies) prefer a consistent and testable slice based reselection outcome and therefore, consider “re-sorting” as a central feature of current work.**

Further, a UE would receive **Slice reselection information** (Slice Info) from the serving cell, listing slice group support in neighboring cells and frequencies. Based on this a UE would have an accurate/ reasonable idea of which of its slice group (among slice groups with priorities received from NAS) is available i.e., supported by at least one neighbouring cell. So, the UE can measure and evaluate only those frequencies considered available based on the Slice reselection information.

**Q2: Do you agree that a UE can/ should limit its measurement and evaluation to only those frequencies considered available based on the Slice reselection information?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/ No** | **Comments** |
| Nokia | No | There can be frequencies that have no slice-based reselection information but have normal reselection information. The UE shall also perform measurements on those frequencies (as defined in Rel-16) before falling back to any cell selection state. |
| Qualcomm | No | Same view as Nokia. In addition, we have agreed RAN4 work is out of scoping. So, there is not spec impact on measurement due to slicing, which means UE follows legacy way of measurement without optimization on slicing info. |
| OPPO | No | We also understand that all frequencies(including the ones without slice-based reselection information) should be measured before UE turns to any cell selection state. If we go with the proposed way as Q2, the measurement behaviour is different from what the UE does currently. |
| CMCC | No | Share similar views with Nokia and QC. We can focus on frequency priority handling and no impact on measurement. |
| Spreadtrum | Neutral | From our side, the above description benefits for shortening the process of reselection. However, the frequency that do not support slice will be added to end of the frequency priority list according to last week agreements.To make it work, some modification to the rules is needed, like slice frequency and legacy frequency are considered separately (i.e., if no suitable cell is found on slice specific frequency, legacy frequency will be considered).  |
| CATT | No | We share the same view with Nokia. |
| Huawei, HiSilicon | No | Agree with Nokia. The UE should perform measurement and evaluation based on the list of sorted frequencies corresponding to both slice based and non-slice based cell reselection priorities.  |
| Xiaomi | No |  |
| NEC | No |  |
| LGE | No | Same understanding as Nokia. |
| KDDI | No |  |
| Samsung | No | Agree with Nokia.RAN2 has already agreed that “*For the frequencies that do not support any slice/slice group, the UE should follow the legacy cell reselection priority received in SIB, FFS when only legacy priority received in RRCRelease;”* |
| Intel | No | All the cell reselectable frequencies will have frequency priority assigned either with slice based frequency priority or legacy cell reselection priority |
| BT | No |  |
| Apple | No | Agree with Nokia. UE performs RRM measurement as legacy way. It is only that the frequencies not supporting slices would be associated with lower priority. |
| Ericsson | No |  |
| T-Mobile USA | No |  |

**Conclusion 2: RAN2 agree that all frequencies, including the ones without slice-based reselection information should be measured before UE turns to any cell selection state.**

### Understanding what is with and without re-sorting

Building on the previous question and based on the following agreed rule:

|  |
| --- |
| *a) 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;* *b) 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);*  |

Any solution works fine if the highest ranked cell of the first frequency (according to the above rules) supports the highest priority available slice group. Therefore, the question really is what happens when the best ranked cell on a frequency does not support a UE’s selected slice.

Based on the two rules above and companies’ response to the previous question, measurement/ evaluation of frequencies for Slice based reselection procedure starts with frequencies supporting its highest priority available slice group. As rule b) clarifies, the frequencies for a UE’s certain available slice group are listed in the slice specific frequency priority order. Now let’s take a very simple example where a UE has been ignaled 2 slices (S1 and S2) from NAS with PriorityS1 > PriorityS2.

For S1 (available on f1 and f2): Priorityf1 > Priorityf2

For S2 (available on f1 and f3): Priorityf1 > Priorityf3

|  |  |  |  |
| --- | --- | --- | --- |
|   | **without re-sorting** |   | **with re-sorting** |
| time instance | frequency | selected slice group | frequency | selected slice group |
| T1 | f1 | S1 | f1 | S1 |
| T2 | f2 | S1 | f2 | S1 |
| T3 | f3 | S2 | f1 | S2 |
| T4 | non-slice based frequencies | f3 | S2 |
| T5 | non-slice based frequencies |

The results for both methodologies (without/ with re-sorting) are consistent until time instance T2. At time instance T3, UE will measure/ evaluate f3 for S2 when no re-sorting is used, and f1 for S2 when re-sorting is used. In the latter case, as soon as the highest priority available slice does not yield (i.e., no successful reselections made for S1), UE prepares a frequency order list according to the next available slice. Of course, there can be other flavors e.g., when f1-S1 does not work at time T1end, UE selects the highest ranked cell on f1 if that supports any of the UE’s slice group. But such additional flavors are ruled-out due to the agreed rules a) and b).

**Q3: Do you agree that re-sorting only/ mainly applies when the slice based reselection procedure for the highest/ higher priority available slice group is exhausted without any yield (i.e., no successful reselections made) and there are still one or more slice group remaining?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/ No** | **Comments** |
| Nokia | Yes |  |
| Qualcomm | Yes, but | We are confused by Rapporteur’s wording in the question. We suggest to use below wording which are from [R2-2203271](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2203271.zip) and R2-2203412 (we understand they are same. Let us know if any misunderstanding):“Re-sorting is applied if the UE performs slice-based cell reselection and if the highest ranked cell, according to neighbouring cell information, does not support the highest priority slice supported by its frequency” |
| OPPO | Yes | While, Re-sorting is also applied for the frequencies which support other slices if the best ranked cell of that frequency does not support the highest priority slice on that frequency. Thus, the words proposed by Qualcomm seems more generic. |
| CMCC | See commentsYes | We understand that this case may happen only when a frequency is sorted only once in the frequency order and the highest ranked cell doesn’t support the highest priority slice. If we agree that a frequency can be sorted multiple times, this case will not exist. |
| Spreadtrum | See comments | The issue that whether a frequency can be sorted multiple times should be discussed firstly. If a frequency can be sorted multiple times for different slices, it will be assigned different frequency priority for different slices in the first sort, thus the case reporter listed will not happen. |
| CATT | See comments | We agree with the comments provided with CMCC. If a frequency can be existed multiple time in frequency list, there is no need to re-sort the reselection priority.  |
| Huawei, HiSilicon | Yes | From the above example, we understand that “re-sorting” means a frequency can be sorted multiple times. Hence, the UE may perform cell reselection based on f1-S2 when the highest ranked cell cannot support S1 with re-sorting. |
| Xiaomi | Yes | And we agree with QC’s rewording. |
| NEC | Yes |  |
| LGE | Yes, see comments | We prefer the wording suggested by Qualcomm. |
| KDDI | See commentsYes | We share the view with CMCC. |
| Samsung | Yes, but see comments |  |
| Intel | Yes with comments | Regarding “i.e., no successful reselections made” in the question, we don’t think UE has to reselect to that frequency before doing the resorting – it is done based on the cell list broadcast in the current cell. |
| BT | Yes |  |
| Apple | Yes | QC’s wording seems fine. |
| Ericsson | Yes |  |
| T-Mobile USA | Yes | Agree with Qualcomm comments. |

**Conclusion 3: Majority (15 out of 17) agree to the provided re-sorting definition. This was further worked on based on company input and clarification was made in an Email from the Rapporteur. Accordingly, “re-sorting” is clarified as a “change of frequency priority of a certain frequency requiring the UE to re-sort the ordered list of frequencies. Re-sorting is applied if the UE performs slice-based cell reselection and if the highest ranked cell of the said frequency, according to neighbouring cell information, does not support the highest priority slice supported by its frequency”.**

To what value the frequency responsible for “re-sorting” is changed, needs to be based on the TPs provided by the companies.

### Comparison:

Please find below a comparison table. **Companies kindly keep adding more benefits, shortcoming and even arguments in favor/ against argument made previously**:

Table

|  |
| --- |
| **Without re-sorting** |
| **Benefits/ advantages** | Shortcoming/ dis-advantages |
| **1) Easy UE implementation and specification** | 1) Not optimal cell reselection from slice support perspective in some cases: E.g., it would fail to reselect to a higher priority frequency/ cell not supporting the highest priority slice, but supporting the 2nd highest priority available slice |
| **2) No re-measurements/ re-evaluation of the same frequency** | 2) Triggers measurement/ evaluation of non-slice based frequencies too early |
| **3) Lower latency in cell reselection as no need either reevaluate measurements on a frequency or perform measurements multiple times on a frequency** | 3) Please add |

And another table for with re-sorting case:

Table

|  |
| --- |
| **With re-sorting** |
| **Benefits/ advantages** | Shortcoming/ dis-advantages |
| **1) Optimal cell reselection from slice support perspective** | 1) Re-measurements or at least re-evaluation will consume time and power *un-necessarily* if the reselections fail again for a freshly selected slice. |
| **2) There may be no need to measure a new frequency (f3 in the above example), if the reselection for a higher priority slice on an already measured frequency works out (S2 on f1)** | 2) Optimization for measurements/ evaluation may need to be left for UE implementation.  |
| **3) Please add** | 3) It may result in longer cell reselection time and higher UE power consumption during cell reselection as it may require repeated measurements on some frequencies |
|  | 4) difficult to integrated into existing cell reselection procedures which is designed for without re-sorting case |

**Q4: Based on the above arguments, do you think slice based reselection procedure should be designed with or without re-sorting functionality?**

|  |  |  |
| --- | --- | --- |
| **Company Name** | **With or Without (re-sorting)** | **Comments** |
| Nokia | without re-sorting | 1) We think that there is no time to properly define a solution with resorting.2) Resorting may have negative impact to the performance (cell reselection time and UE power consumption during cell reselection), as it may require repeated measurements on a frequency |
| Qualcomm | With re-sorting | We suggest to follow the way proposed in [R2-2203271](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2203271.zip) and R2-2203412 (We understand they are same. Let us know if any misunderstand). They are simple: when the condition is met (i.e., best ranked cell doesn’t support highest priority slice), the UE re-calculates the frequency priority order by considering all slices except the highest priority slice. The accurate wording can be:“If the UE performs slice-based cell reselection and if the highest ranked cell, according to neighbouring cell information, does not support the highest priority slice supported by its frequency, the UE only considers the slices supported by the highest ranked cell among the NAS provided slice or slice group for slice specific rioritization as in section 5.2.4.X for this frequency, until the highest ranked cell changes or NAS provides a new set of slices or slice groups.“ |
| OPPO | See comments | For measurement, we understand there should be no re-sorting and we understand that the UE only needs to measure each frequency once. The frequency priority of each frequency is associated with the highest priority available slice on that frequency.For cell reselection criteria check, we need at most one re-sorting if the best ranked cell of one frequency does not support the highest priority available slice on that frequency. For this case, we use the frequency priority associated with the highest priority available slice on that cell (in the case that cell supports any UE intended slice) or use the legacy frequency priority of that frequency (in the case that cell does not support any UE intended slice).  |
| CMCC | Prefer each frequency can appear multiple times in the sort pool, and no re-calculate is needed.Acceptable for each frequency only appears once in the sort pool, and re-calculate is needed. | Same as our comments in Q1.In addition, if there is no consensus on this issue, we try to provide **a compromise principle**:If the best ranked cell does not support the highest priority slice supported by its frequency, the UE considers other NAS prioritized slices, but the exact method (e.g. a frequency sorted once + re-calculate, a frequency sorted multiple times + no re-calculate) can be up to UE implementation. |
| Spreadtrum | Without re-sorting | There is no need to introduce re-sorting.  |
| CATT | See comments? | We agree with CMCC that the exact method can be left to UE implementation.  |
| Huawei, HiSilicon | With re-sorting | We have some views on dis-advantages in Table 2:* For 1), we wonder whether the UE needs to do re-measurements or not because the UE has already got the measurements for the same frequency. It requires the UE to do the re-evaluation and the cost is not so much
* For 3), the UE only needs to do the re-evaluation and we do not think the impacts on cell reselection time and UE power consumption are not much

However, we can be also ok to leave it to UE implementation. |
| Xiaomi | See comments | Share the same view with OPPO. |
| NEC | Without  |  with so much exercise in the past, we feel there is not time to define a clear but not too complicated specification, on the other hand, if we leave too much to UE implementation, and NW will lose the control, it will discourage the implementation of the feature |
| LGE | With re-sorting, See comments | To find a proper cell during slice based cell reselection, re-sorting is preferred. We’d like to clarify that the UE doesn’t need perform measurement each re-sorting.  |
| KDDI | See comments | We propose to go without re-sorting for Relase17 and postpone the work for re-sorting to Release18 as a compromise. |
| Samsung | With resorting | Same view as Qualcomm. |
| Intel | With resorting or re-arranging(See comments) | It is not clear to us if no resorting is done what is the UE behaviour? |
| BT | With re-sorting | BT views:1. Re-sorting does not mean UE re-measurements. How UE does the measurements can be left to UE implementation.
2. Without UE re-measurements, delay is the same with and without re-sorting.
 |
| Apple | With re-sorting |  |
| Ericsson | With “re-sorting” | Same view as Qualcomm, Intel et all. |
| T-Mobile USA | With re-sorting |  |

**Conclusion 4: 12 companies prefer “with re-sorting” [QC, Oppo, CMCC, HW/ HiSi, Xiaomi, LGE, Samsung, Intel, BT, Apple, Ericsson, T-Mobile USA] as opposed to 4 companies [Nokia, Spreadtrum, NEC, KDDI] for “without re-sorting”.**

Based on the conclusions from previous two sections, following proposals are made:

**Proposal 1: Re-sorting is defined as a change of frequency priority of a certain frequency requiring the UE to re-sort the ordered list of frequencies.**

**Proposal 2: RAN2 agree that a re-sorting is applied if the UE performs slice-based cell reselection and if the highest ranked cell of the said frequency, according to neighbouring cell information, does not support the highest priority slice supported by its frequency.**

## Equal Priority case

Following is the situation from the Friday morning situation (RAN2#117)

*Proposal 4: FFS how to handle the frequency priority among the frequencies supporting the same slice/slice group with same frequency priority.*

*(7/19) Option 1: the frequency supporting maximum intended slices may be prioritized;*

*(13/19) Option 2: they are considered as equal priority;*

*(10/19) Option 3: up to UE implementation;*

From option 3, leaving this case to UE implementation will lead to different outcomes. Further, Option 2 is no different since a UE would need to prioritize “somehow” between the frequencies considered as equal priority. Is it then reasonable to say that there are really only two possibilities.

*Option 1: the frequency supporting maximum intended slices may be prioritized (an example TP is in R2-2202514)*

*Option 3: up to UE implementation*

***Q5: Do you agree that there are really only two options (1 and 3 above)?***

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/ No** | **Comments** |
| Nokia | No | There is a clear specification on handling equal priority NR frequencies in 5.2.4.6 (“Intra-frequency and equal priority inter-frequency Cell Reselection criteria”) in 38.304. We do not understand why this cannot be applied in this case. (Note also that option 2 was the most popular in the previous email discussion.) |
| Qualcomm | See comments | Same understanding as Nokia that we only need to follow legacy principle to handling equal priority frequency in 5.2.4.6. |
| OPPO | See comments | Similar understanding as Nokia and Qualcomm. If Option 2 is chosen, we can reuse the legacy principle.  |
| CMCC | No |  |
| Spreadtrum | No | Option 2 should be preserved.In our understanding, when using the option 2, all the frequencies that have the same equal priority will be measured. And the highest ranked cell among the cells on those frequencies will be selected as in legacy way. |
| CATT | No |  |
| Huawei, HiSilicon | No | We have similar understanding as Nokia. |
| Xiaomi | No  |  |
| NEC | No  | Agree with Nokia, this is not something new  |
| LGE | No |  |
| KDDI | No |  |
| Samsung | No | We can just follow the legacy principle. |
| Intel | No |  |
| BT | No |  |
| Apple | No |  |
| Ericsson | No |  |

**Q6: Do you think this decision is one fundamental to the SI/ WI intention or can be considered an optimization?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes (=fundamental) / No (=optimization)** | **Comments** |
| Nokia | Yes | We think that there is a good reason that equal priority NR frequency reselection has been specified. |
| Qualcomm | Yes | Same view as Nokia |
| OPPO | Yes |  |
| CMCC | Yes |  |
| Spreadtrum | Yes |  |
| CATT | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Xiaomi | Yes |  |
| NEC | Yes |  |
| LGE | Yes |  |
| KDDI | Yes |  |
| Samsung | Yes |  |
| Intel | Yes |  |
| BT | Yes |  |
| Apple | Yes |  |
| Ericsson | Yes |  |

**Q7: Finally, which Option do you prefer?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option (1 or 3)** | **Comments (in case of Option 3, please indicate if you like to use a “Note” for this purpose)** |
| Nokia | Option 2  | Neither option 1 nor option 3 are acceptable. |
| Qualcomm  | Option 2 with edit on wording | We only need to follow legacy principle to handling equal priority frequency in 5.2.4.6. Thus, we suggest to modify option 2 as below (to avoid misunderstanding):*Option 2: they are considered as equal priority, as the legacy way in section* *5.2.4.6 of TS 38.304* |
| OPPO | Option 2 |  |
| CMCC | Option 1 | If the frequency supporting maximum intended slices is prioritized, more slices are available for the UE.Option 2 and 3 are also acceptable. |
| Spreadtrum | Option 2 | We are OK with option 2. |
| CATT | Option1 | This can reduce the possibility of performing slice based cell reselection when the other intended slices are wanted.  |
| Huawei, HiSilicon | Option 2 |  |
| Xiaomi  | Option 2/3 |  |
| NEC | Option 2 or option1 is also fine to us |  |
| LGE | Option 1 | Same comment as CATT |
| KDDI | Option2 |  |
| Samsung | Option 2 |  |
| Intel | Option 2 | Definitely not Option 3. |
| BT | Option 1 or option 2 | We have concerns on option 3. It will difficult the network engineering phase and testability.  |
| Apple | Option 1 |  |
| Ericsson | Option 2 |  |

**Conclusion 5: An absolute majority considers that dealing with Equal Priority case is fundamental to our work. 12 companies prefer or are fine with Option 2, and 4 companies support only option 1. Therefore, we can try to agree on the following proposal:**

**Proposal 3: UE behaviour for frequencies determined as “equal priority” is defined similar to UE behaviour for the case of equal priority NR frequencies in 5.2.4.6 (“Intra-frequency and equal priority inter-frequency Cell Reselection criteria”).**

## Text Proposals

For with re-sorting based solution, following TPs are available:

1. [R2-2203271](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2203271.zip) Text Proposal for 38.304 on cell reselection for RAN slicing Samsung R&D Institute UK, Qualcomm Incorporated, OPPO discussion
2. [R2-2202514](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2202514.zip) Text Proposal for slice based cell re-selection Apple, BT plc discussion Rel-17 NR\_slice-Core
3. [R2-2203183](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2203183.zip) Way forward and TP for RAN Slicing solution Lenovo, Motorola Mobility discussion NR\_slice-Core

For without re-sorting based solution, following TPs are available:

1. [R2-2203071](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2203071.zip) Slice-based cell reselection proposal Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_slice-Core
2. [R2-2203234](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2203234.zip) Cell reselection relevant open issues (38.304) NEC Telecom MODUS Ltd. discussion

**Q8: Based on your answer to Q4, kindly indicate which TP do you prefer and why.**

|  |  |  |
| --- | --- | --- |
| **Company** | **TP (1, 2, 3, 4 or 5)** | **Comments** |
| Nokia | 4 | As it is targeting a solution without resorting |
| Qualcomm | 1  | One of the proponents. We think 1 most follows the following basic principle of current 38.304:* Only rules are specified
* The procedure how the UE realizes frequency prioritisations are not specified (e.g., it allows UE to a Matrix if it is capable of simultaneously evaluating more than 1 frequencies).

Because 5 basic rules have been agreed in last Friday, we think agreeing 1 will mean the CR work is finalized.  |
| OPPO | 1 | It is aligned with what we already agreed and reflects our main intention. |
| CMCC | Prefer 2 Acceptable for 1 | As we comment in Q4, if there is no consensus, we try to provide **a compromise principle**:If the best ranked cell does not support the highest priority slice supported by its frequency, the UE considers other NAS prioritized slices, but the exact method (e.g. a frequency sorted once + re-calculate, a frequency sorted multiple times + no re-calculate) can be up to UE implementation. |
| Spreadtrum | 1 | We prefer 1 as the starting point as it basically captures the rules achieved in last week. |
| CATT | Option 1 | This option aligns with the current agreement. |
| Huawei, HiSilicon | 1 | The TP in 1 is aligned with the RAN2 agreements, and it can be used as a baseline. |
| Xiaomi | 1 | With the further clarification on how to handle the collision of the frequency priority decided by rule a) an rule b) , and priority collision based on different slice specific reselection priority in rule b), as we point out in [241].Anyway, it can be considered as baseline. |
| NEC | See comment | Proponent to TP5 of compromise solution, in which only one selected higher priority slice is considered At the same time, we are open to discuss other TPs which is more align with current agreements: For TP1-3, it is not clear for us how to integrate the principles into other cell reselection sections, e.g., measurement rule section, in which the UE behaviour is highly linked to frequency priorities. once the priority will be re-calculated or different with regarding to different slices, we have to clarify how to interpret these sections.For TP4, As it mentioned “it is not guaranteed that slice group specific frequency priorities are higher than the "normal" (non-slice specific) frequency priorities. “ in our understanding, same reason, it is not guaranteed that frequency priorities with regarding to higher slice group are higher than the frequency priorities with regarding to lower slice group. Hence a frequency supporting higher priority slice group may end up have lower priority supporting lower priority slice group. Other than this, TP4 at least is complete and clear |
| LGE | 1 | Option 1 could be baseline. |
| KDDI | 4 | We can go without re-sorting for Release 17. We can discuss Text proposals for re-sorting in Relase18 as an enhancement. |
| Samsung | 1 | As mentioned by Qualcomm, we just need to define one additional rule with TP1 and it is in-line with current 38.304, ensuring consistent behaviour while leaving what is in “implementation domain” now to implementation. |
| Intel | 1 or R2-2203412 | We prefer Option 1 or the R2-2203412 as the baseline. |
| BT | 2 |  |
| Apple | 2 |  |
| Ericsson | 1 | We agree with Intel. |

# Conclusion

Following conclusions and proposals are being made; **it is sufficient to treat only the proposals online**:

Conclusion 1: Majority (11 out of 16 companies) prefer a consistent and testable slice based reselection outcome and therefore, consider “re-sorting” as a central feature of current work.

Conclusion 2: RAN2 agree that all frequencies, including the ones without slice-based reselection information should be measured before UE turns to any cell selection state.

Conclusion 3: Majority (15 out of 17) agree to the provided re-sorting definition. This was further worked on based on company input and clarification was made in an Email from the Rapporteur. Accordingly, “re-sorting” is clarified as a “change of frequency priority of a certain frequency requiring the UE to re-sort the ordered list of frequencies. Re-sorting is applied if the UE performs slice-based cell reselection and if the highest ranked cell of the said frequency, according to neighbouring cell information, does not support the highest priority slice supported by its frequency”.

Conclusion 4: 12 companies prefer “with re-sorting” [QC, Oppo, CMCC, HW/ HiSi, Xiaomi, LGE, Samsung, Intel, BT, Apple, Ericsson, T-Mobile USA] as opposed to 4 companies [Nokia, Spreadtrum, NEC, KDDI] for “without re-sorting”.

Conclusion 5: An absolute majority considers that dealing with Equal Priority case is fundamental to our work. 12 companies prefer or are fine with Option 2, and 4 companies support only option 1.

**Proposal 1: Re-sorting is defined as a change of frequency priority of a certain frequency requiring the UE to re-sort the ordered list of frequencies.**

**Proposal 2: RAN2 agree that a re-sorting is applied if the UE performs slice-based cell reselection and if the highest ranked cell of the said frequency, according to neighbouring cell information, does not support the highest priority slice supported by its frequency.**

**Proposal 3: UE behaviour for frequencies determined as “equal priority” is defined similar to UE behaviour for the case of equal priority NR frequencies in 5.2.4.6 (“Intra-frequency and equal priority inter-frequency Cell Reselection criteria”).**