3GPP TSG-RAN WG2 Meeting #117 Electronic R2-22xxxxx

Elbonia, Feb 2022

**Agenda item: 8.10.3.1.1**

**Source: ZTE corporation, Sanechips**

**Title: Report of [Pre117-e][NTN][102] Idle mode open issues**

**Document for: Discussion and Decision**

# 1 Introduction

This is the summary of the following pre-meeting discussion.

* [Pre117-e][NTN][102] Idle mode open issues

Scope: Continue the discussion on idle mode open issues listed in R2-2201898:

- issue 1 and 3-10 will be handled in offline discussion [Pre117-e][NTN][102] Idle mode open issues

- issue 2 will be split among offline [Pre117-e][NTN][101] (ASN.1 aspects of ephemeris signalling) and offline [Pre117-e][NTN][102] (How the satellite ephemeris can assist cell reselection and under what circumstance UE will perform cell selection/reselection based on satellite/HAPS ephemeris)

- issue 11 will be handled in offline discussion [Pre117-e][NTN][101]

Initial intended outcome: Summary of the offline discussion with e.g.:

* + - List of proposals for agreement (if any)
    - List of proposals that require online discussions
    - List of proposals that should not be pursued (if any)

Initial deadline (for companies' feedback): Feb 14

Initial deadline (for rapporteur's summary): Feb 17

# 2 Contact information

|  |  |
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# 3 Open issue list

Open issues listed in R2-2201898:

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**Open issue 1:**Which option to adopt for location-based reselection?

-      Option 1: only neighbor cells with distance shorter than a threshold will be considered during cell reselection ;

-      Option 1b: exclude neighbor cells too far away i.e., distance longer than a threshold will not be considered during cell reselection ;

-      Option 2: distance based ranking is used together with legacy R criteria.

-     Other options?

[Rapporteur] Covered in this pre-meeting discussion [102].

**Open issue 2:** For cell selection and reselection in NTN, the satellite/HAPS ephemeris may be used by UE. The ephemeris is divided into serving cell’s ephemeris and neighbor cells’ ephemeris.  FFS on the definition of satellite/HAPS ephemeris , under what circumstance UE will perform cell selection/reselection based on satellite/HAPS ephemeris and how would the serving cell’s ephemeris and neighbor cells’ ephemeris differ regarding e.g. the required accuracy or signaling impact.

[Rapporteur] How the satellite ephemeris can assist cell reselection and under what circumstance UE will perform cell selection/reselection based on satellite/HAPS ephemeris covered in this pre-meeting discussion [102]. The signaling of ephemeris i.e. ASN.1, covered by pre-meeting discussion [101].

**Open issue 3:**Whether Time-based and location-based reselection can be configured simultaneously? If Yes, what is the expected UE behavior when configured together?

[Rapporteur] Covered in this pre-meeting discussion [102].

**Open issue 4:**Any further enhancement on cell reselection priority configuration in NTN?

[Rapporteur] Covered in this pre-meeting discussion [102].

**Open issue 5:**Whether the timing information about new upcoming cell is needed for quasi-earth fixed cell and/or earth moving cell? FFS if such information is known from system information and/or the ephemeris. FFS on the utilization of such information.

[Rapporteur] Covered in this pre-meeting discussion [102].

**Open issue 6:** Regarding UE-based solution for SMTC adjustments in idle and inactive mode, UE autonomously adjust the SMTCs based on location and ephemeris. FFS whether NW assistance information is provided.

[Rapporteur] FFS whether NW assistance information is provided is covered in this pre-meeting discussion [102].

**Open issue 7:**Any enhancement on the SMTC broadcast for measurements in idle and inactive mode?

[Rapporteur] Covered in this pre-meeting discussion [102].

**Open issue 8:** Any enhancement on TN prioritization over NTN?

[Rapporteur] Covered in this pre-meeting discussion [102].

**Open issue 9:** How to prevent non-NTN capable UEs from accessing an NTN cell?

[Rapporteur] Covered in this pre-meeting discussion [102].

**Open issue 10:** Does UE need to be aware whether an NTN cell is quasi-fixed or earth moving? If Yes, how?

[Rapporteur] Covered in this pre-meeting discussion [102].

**Open issue 11:** The ntnUlSyncValidityDuration applies to the whole SIBX. UE acquires the updated SIBX when the timer expires. FFS whether to also include it in the LS to RAN1. FFS if this applies only to connected mode or to idle mode UE as well.

[Rapporteur] Covered in pre-meeting discussion [101].

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# 3 Discussion

## **Open issue 1: location-based reselection**

The following agreements have been made to support location-based reselection in NTN.

**RAN2#116e:**

Location assisted cell reselection, with the distance between UE and the reference location of the cell (serving cell and/or neighbour cell) taken into account, is supported for quasi-earth fixed cell. FFS on how UE performs location acquisition.

Regarding the utilization of the distance between UE and the reference location of the cell (serving cell and/or neighbor cell), the following options have been proposed and discussions in the past meetings:

-      Option 1: only neighbor cells with distance shorter than a threshold will be considered during cell reselection;

-      Option 1b: exclude neighbor cells too far away i.e., distance longer than a threshold will not be considered during cell reselection;

-      Option 2: distance based ranking is used together with legacy R criteria.

-     Other options?

**Question 1: On utilization of the distance between UE and the reference location of a cell in cell reselection, which option do companies prefer?**

|  |  |  |
| --- | --- | --- |
| Company | Option 1/1b/2 or other | Detailed Comments |
| Huawei, HiSilicon | Option 1 |  |
| Samsung | Option 2 (See comments) | We think even with location based cell reselection criteria, the legacy cell reselection criteria (R criteria based on RSRP and/or RSRQ) should be considered as baseline. Option1(b) seems legacy R criteria is not applied. |
| Lenovo, Motorola Mobility | Option 1 or 1b with comments | Option 1 and 1b are actually the same restriction but we think it should be further explained including how to do cell ranking for the cells with distance shorter than a threshold. Our understanding is that, compared to Option 2, in Option 1 or 1b the distance only works as a threshold to decide which cells are considered as candidate, and the candidate cells are ranked by legacy R criteria. |
| Google | Option 1 |  |
| Transsion | Option 1 |  |
| vivo | Option 1 | It seems that open issue 1 is mainly for the intra-frequency and equal priority inter-frequency reselection criteria, we think that the location-based cell reselection criterion should also be introduced for higher priority frequency and lower priority frequency cell reselection. We think only the neighbour cells with distance shorter than the threshold will be considered to determine whether the UE shall perform cell reselection, i.e. only the impacts on the cell reselection criteria in 5.2.4.5 (inter-F) and 5.2.4.6 (intra-F) are needed. |
| Nokia | Other | The use of location in IDLE mode is still somewhat questionable. The reference location of the cell (serving or target) may be broadcast, but corresponding UE’s behavior does not need to be defined if we cannot expect the UE will always have credible and up-to-date location information available, as the latter is what companies in RAN2 are eager to conclude. |
| Sony | Option 1 | We think option 1 is easier to implement. |
| MediaTek | Option 1 | For this release Option 1 is enough. |
| Qualcomm | Other | There is no guarantee that the UE will be provided with all the neighbor cell reference locations. So only feasible is option 1b. But we think it is sufficient just to have measurement trigger condition based on UE location. |
| CATT |  | Taking the distance into account will increase the complexity of cell reselection criteria. We need to further consider the problem bring by different cell size, like GEO cell and LEO cell. And we think the legacy criterion can be work well. But if most companies can accept Option 1 or 1b, we are ok. |
| Xiaomi | Option 1 with comments | Based on option 1, UE may only select to the satellite with the lowest altitude and can’t reselect to the high altitude such as GEO. So how to define the distance between UE and satellite should be considered and the distance should be uniformed |
| Intel | option 1 |  |
| Apple | Option 1 or 1b | With the understanding that UE is not forced to acquire location to apply location based reselection. We think that 1 and 1n are essentially the same options. |
| China Telecom | Option 2 | First, we emphasis R criteria should be the baseline for cell reselection procedure. Radio link condition is essential for cell reselection. Second, location information is useful to overcome the not obvious near-far effect in NTN scenario. We observe that even though some companies choose Option 1 or 1b, they still use R criteria for ranking within a location threshold. Thus, we prefer the combination of location and radio criteria for better performance and choose Option 2 |
| Spreadtrum | Option 1 | If UE could always determine its location, option1 is simple. |

## **Open issue 2: Satellite ephemeris assisted cell reselection**

The following agreements have been made on satellite ephemeris assisted cell reselection:

**RAN2#111e**

Satellite/HAPS ephemeris based cell selection and reselection should be defined for NTN (FFS what the term satellite/HAPS ephemeris actually means). FFS when this ephemeris based cell selection / reselection can be used. FFS whether UE location (and/or other information) based cell selection and reselection should be introduced for NTN

However, there has not been much discussion on how to use the satellite ephemeris to assist cell reselection, under what circumstance UE will perform cell selection/reselection based on satellite/HAPS ephemeris and the expected UE behavior.

In the past discussions, some examples have been given on how to use the satellite ephemeris in cell reselection. For example, the satellite type, i.e. GEO or NGSO, can be inferred from ephemeris and can be used by UE to determine whether to camp or not.

Thus, the rapporteur would like to understand what kind of information included or inferred from ephemeris would be useful in cell reselection and the expected UE behavior when using such information.

**Question 2: What kind of information included or inferred from ephemeris would be useful to assist cell reselection? And what is the expected UE behaviour when using such information in cell reselection?**

|  |  |  |
| --- | --- | --- |
| Company | Information included or inferred from ephemeris that is useful in cell reselection | Expected UE behavior when using such information in cell reselection |
| Huawei, HiSilicon | Our understanding is that “Satellite/HAPS ephemeris based cell selection and reselection” was a term to illustrate the overall NTN selection/reselection enhancements. Considering the agreements achieved in later meetings, “Satellite/HAPS ephemeris based cell selection and reselection” is represented by time-based reselection and location-based reselection. The ephemeris information can help to configure time/location-based reselection parameters (t-Service, reference location).  Or, to answer the question literally (what information can be inferred by the UE from ephemeris), service link delay between UE and serving/neighbor cell can be deduced to assist SMTC adjustment for Idle/Inactive mode UEs | Time/location-based measurement triggering, location-based reselection, SMTC adjustment. |
| Samsung | If timing information and location information of the serving and neighboring cell(s) are part ephemeris information, it would be useful. In addition to satellite location information, the feedback link delay would be useful for UE-based SMTC adjustment. | Time/location-based measurement triggering, location-based reselection, SMTC adjustment. |
| CMCC | Some assistance information such as propagation delay(difference), t-service and network type, etc. could be deduced by the UE together with the UE location. | Adjust SMTC configuration, help to implement location/time based reselection |
| Lenovo, Motorola Mobility | We share Huawei’s view that “Satellite/HAPS ephemeris based cell selection and reselection” was a term to illustrate the overall NTN selection/reselection enhancements. In our understanding the current enhancements agreed have fulfilled the essential needs in IDLE mobility, and there is no need to further consider ephemeris-based reselection in this release.  Or, another understanding is as in Samsung’s view, the reference location and the stop serving time are part of the ephemeris, and the enhancements based on these have been agreed. | Time-based neighbour cell measurement triggering,  distance-based neighbour cell measurement triggering and candidate cell determining, , SMTC adjustment in IDLE. |
| Google | Since the time-based and location-based (with the assistance of reference location) cell reselection has been agreed and implemented, we think this agreement made in RAN2#111e has been superseded and there is no need to discuss the details. |  |
| Transsion | Currently there are two approaches, time-based and location-based, which were sufficient for quasi-earth fixed cell reselection.  For the ephemeris based cell reselection would be more suitable for moving cell. | For quasi-earth fixed cell, using time-based/location-based perform cell reselection.  For moving cell, using ephemeris based cell reselection. |
| vivo | We share a similar view with Huawei, time-based cell reselection and location-based cell reselection are the result of a further discussion of satellite/HAPS ephemeris based cell reselection. In addition to time/location-based cell reselection, RAN2 does not need to discuss other enhancements for cell reselection.  t-Service, reference location of serving cell and neighbour cell(s) are useful in cell reselection. | SMTC adjustment which impacts the measurements at the UE side.  Other usage, e.g. configuring time/location based parameters, are located at the NW side for configuration. No direct impact on UE behaviour. |
| Nokia | We understand the parameters for reselection (such as cell stop time or reference location) and the ephemeris (PVT/orbital parameters, see RAN1 decisions) are two separate things. We do not need to specify what the UE can infer from the ephemeris and its corresponding behavior. |  |
| MediaTek | Agree with Apple that time-based and location-based (with the assistance of reference location) cell reselection has been agreed and this agreement made in RAN2#111e has been superseded and does not need further discussion. Orbital parameters or PV Information could be processed to send the distance of the neighbour cells. | Use the distance for distance-based cell reselection |
| Qualcomm | UE should be provided with ephemeris and beam information (cell center/coverage info).  If available, common TA parameters should also be provided to UE. | This can be used for neighbor cell measurement.  The UE can estimate roughly how long it can stay in a moving cell and accordingly plan the frequency measurement.  We are open if GSO vs NGSO priority needs to be defined for cell reselection. |
| CATT |  | Taking the distance into account will increase the complexity of cell reselection criteria. We need to further consider the problem bring by different cell size, like GEO cell and LEO cell. And we think the legacy criterion can be work well. But if most companies can accept Option 1 or 1b, we are ok. |
| Xiaomi | We also think “Satellite/HAPS ephemeris based cell selection and reselection” is represented by time-based reselection and location-based reselection. And other enhancements for cell reselection is not needed. | Time/location-based measurement triggering, location-based reselection, SMTC adjustment. |
| Intel | We also think “Satellite/HAPS ephemeris based cell selection and reselection” is represented by time-based reselection and location-based reselection. |  |
| China Telecom | Agree with Xiaomi and Intel | Time/location-based measurement triggering, location-based reselection, SMTC adjustment. |
| Spreadtrum | If UE could always determine its location and the reference point of fixed cell, location-based reselection works well, otherwise, time-based reselection is better. |  |

## **Open issue 3: Configuration of time and location based cell reselection**

The following agreements have been made on time based reselection:

**RAN2#115e**

1. Broadcast of cell stop time in SIB is only applicable to quasi earth fixed cell (not to moving cell). No further work in this release to address any moving cell specific details on using the cell stop time to assist measurements or cell reselection
2. For quasi-earth fixed cell, the reference location of the cell (serving cell or the neighbor cells) is broadcast in system information
3. For quasi-earth fixed cell, UE should start measurements on neighbour cells before the serving cell stops covering the current area.
4. For quasi-earth fixed cell, the broadcast “timing information on when a cell is going to stop serving the area” refers to the time when a cell stops covering the current area.
5. For quasi-earth fixed cell, specify that UE should start measurements on neighbour cells before the broadcast stop time of the serving cell, i.e. the time when the serving cell stops covering the current area, and the exact time to start measurements is up to UE implementation.

**RAN2#116e**

For quasi-earth fixed cell, UE should start measurements on neighbour cells before the serving cell stops covering the current area, regardless of (the distance between UE and serving cell reference location) or (if legacy Srxlev/Squal condition is met, i.e., serving cell’s Srxlev/Squal is better than a threshold).

**RAN2#116bis-e**

1. For quasi-earth fixed cell, same as legacy, UE shall perform neighbour cell measurements of “higher priority NR inter-frequency or inter-RAT frequencies” regardless of the remaining serving time.
2. Before the stop-time based measurements are triggered, the UE measurements follow Legacy behaviour (i.e., based on Srxlev/Squal) and there is no measurement relaxation.
3. Cell stop time is not applied to cell ranking in determining the target cell for reselection.

The following agreements have been made on location based reselection so far:

**RAN2#116bis-e**

1. Location information can be used to determine when to start measurement.

2. UE may choose not to perform neighbour cell measurements of “NR intra-freq or inter-freq with equal or lower priority, or inter-RAT freq with lower priority”, if (the distance between UE and serving cell reference location is shorter than a threshold) and (legacy Srxlev/Squal condition is met, i.e., serving cell’s Srxlev/Squal is better than a threshold).

3. Location-based measurement initiation is only applied if the cell broadcasts location-related parameters (e.g. a threshold) and by implementation the UE has location information.

**Question 3: Whether Time-based and location-based reselection can be configured simultaneously? If Yes, what is the expected UE behaviour when configured together?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Expected UE behavior when configured together |
| Huawei, HiSilicon | Yes | UE can choose to apply one or both of them, which is determined by UE implementation. When UE chooses both of them, the measurement should be started if either time based condition or location based condition is satisfied. |
| Samsung | No | We think cell reselection criteria should be controlled by the network (for idle mode UE’s load control in general). If the network configures both and which one to be used is determined by UE implementation, the consequence would be different per UE and it is not predictable by the network. For simplicity, we prefer either time-based or location-based cell reselection criteria is configured since legacy cell reselection criteria will be applied together. |
| CMCC | Yes with comments | Maybe both time-based and location-based reselection can be configured, however, it is enough to use one of them at the same time. |
| Lenovo, Motorola Mobility | Yes | We would like to make it open to network configuration for flexibility. And in quasi-fixed scenario the distance-based and time-based reselection could be needed at the same time, e.g. when a UE is approaching cell edge and the satellite is about to stop serving. |
| Google | Yes | Network can configure both simultaneously. If either the time-based or the location-based condition is fulfilled for triggering the measurement, UE shall perform the measurement. |
| Transsion | Yes | UE can perform cell reselection once one of them is satisfied. |
| vivo | Yes | For measurement triggering, time-based and location-based reselection can be configured simultaneously. When time-based and location-based reselection are configured simultaneously, UE should apply both of them.  For higher priority NR inter-frequency or inter-RAT frequencies, same as legacy, UE shall perform neighbour cell measurements regardless of the time-based condition and location-based condition.  For NR intra-freq or inter-freq with equal or lower priority, or inter-RAT freq with lower priority, UE shall perform neighbor cell measurements if either time-based condition or location-based condition is satisfied. |
| Nokia | No | A similar problem was considered for CONNECTED mode and there was no support for such mixture for Conditional Handover (CHO) triggering. Thus, for simplicity, the same principle can be adopted for IDLE mode. One may say that location- and time-based reselection can be helpful if e.g. the UE is in the middle of the cell (so location-based reselection does not trigger), while the cell is about to be switched off (footprint will disappear). However, in our understanding, the time-based triggering shall play a decisive role in this scenario and the combination with location-based cell reselection is not needed if time-based information is provided. |
| Sony | No |  |
| MediaTek | No | Agree with the concerns raised by both Nokia and Samsung. |
| Qualcomm | No |  |
| CATT | Yes | Agree with Lenovo, Motorola Mobility. |
| Xiaomi | No | Agree with Samsung and Nokia. |
| Intel | No |  |
| Apple | Yes | There is benefit in configuring both in order to reduce measurements. Also the network cannot be certain that the UE is applying location based reselection, e.g., if GNN location is not available at the UE. |
| China Telecom | No | Either can work for cell reselection. No need to configure both and introduce the complexity. |
| Spreadtrum | No | It is complex for UE, if both time-based and location-based cell reselections are configured to UE. |

## **Open issue 4: Further enhancement on cell reselection priority configuration in NTN**

**Question 4: Any further enhancement on cell reselection priority configuration in NTN? If Yes, please clarify the use case and the detailed enhancement.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Use case and the detailed enhancement |
| Huawei, HiSilicon | No |  |
| Samsung | No | We think the existing cell reselection priority configuration would be sufficient. |
| Lenovo, Motorola Mobility | No |  |
| Google | No |  |
| Transsion | No | Legacy priority reselection is sufficient. |
| vivo | No |  |
| Nokia | No | Existing priorities are sufficient. |
| Sony | No |  |
| MediaTek | No | R-16 priorities are sufficient to do this. |
|  |  |  |
| CATT | No |  |
| Xiaomi | No |  |
| Intel | No |  |
| Apple | No |  |
| China Telecom | No |  |
| Spreadtrum | No |  |

## **Open issue 5: Timing information about the new upcoming cell**

It has been proposed to provide the start time of the new upcoming cell to UE to assist cell reselection without reaching any consensus.

**Question 5.1: Whether the timing information about new upcoming cell is needed for quasi-earth fixed cell and/or earth moving cell? If Yes, what is the expected UE behaviour when using such information to assist cell reselection?**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Yes/No | | Expected UE behavior when using such information to assist cell reselection |
| **Fixed cell** | **Moving cell** |
| Huawei, HiSilicon | See comments | No | For fixed cell, will there be a large gap between the stop time of serving cell and the start time of upcoming cell? We think the stop time is enough, and the “timing information” seems unnecessary.  Broadcasting the frequency/PCI information of upcoming cell can be useful in:  1) Measurements: UE can start measuring the upcoming cell.  2) Cell ranking: UE can prioritize the upcoming cell, or only consider the upcoming cell as target cell.  However, we are not sure whether this has any spec impact. The network can configure the upcoming cell in intraFreqWhiteCellList or interFreqWhiteCellList, and the UE shall consider only the white listed cells, if configured, as candidates for cell reselection. |
| Samsung | Yes | Open | Without the information of incoming (serving) cell, the UE performs measurements on all intra-F and inter-F neighboring cells when the stop time of the current serving cell comes closer. Note for quasi-earth fixed cell case, we think the incoming (serving) cell would be located in different inter-F due to interference issue. In NTN, we think measurement only on incoming (serving) cell should be sufficient in most cases and it can provide much UE power saving gain. Some argued whitelist can work but we think whitelist will restrict the whole candidate cells for cell reselection while the intention here is to select incoming (serving) cell among all candidate cells for cell reselection. Also with whitelist, the UE needs to wake-up more often to acquire every update of whitelist, which throws away power saving gain. Note we think we may not need separate timing information (at least for quasi-earth fixed cell case), we just reuses the existing the stop time of the current serving cell but the information of incoming (serving) cell is needed. |
| CMCC | See comments | No | With the stop time of serving cell is sufficient, and the the timing information of up coming cell could also provide some benefits. So we are fine to go for the majority. |
| Lenovo, Motorola Mobility | See comments | No | For Rel-17 NR NTN. stop time of serving cell is sufficient, as long as the network coverage is assumed to be continuous, and the UE only needs to know when it has to start neighbour cell measurement accordingly. But if we consider discontinuous coverage (e.g. as in IoT NTN) by sparse satellite constellation, timing information about new upcoming cell is useful. We are fine to reuse IoT NTN agreements in this release, or consider this in future releases. |
| Google | No | No | We understand the timing information of the new upcoming cell can be used in cell reselection and might be beneficial, but we prefer to not re-open the discussion at this stage as it has been discussed several times before and the conclusion is RAN2 only agrees to broadcast the stop time for the serving cell (which must be a quasi-Earth fixed cell). |
| Transsion | See comments | No | For fix cell, current stop serving time should be enough, the needed is depend on NTN cell deployment. If NTN cells are continuously provide coverage for a certain area, the stop time of serving cell is satisfied, but for discontinuous coverage case, the time information of upcoming cell would result UE in different reselection decision. |
| vivo | No | No |  |
| Nokia | No | No for the upcoming, can be supported for current serving | We think the information about the current serving should be enough to decide when is the right time to do a reselection. |
| Sony | Yes | Yes | The upcoming cell information would be beneficial to optimize measurement performance. |
| MediaTek | Yes | No | Leave the UE behaviour on UE implementation. |
| Qualcomm | Yes (but not time) | Yes (but not time) | We think only frequency/PCI of the next/upcoming cell would be enough. As with cell stop timer or ephemeris/beam information, the UE would be able to estimate cell service time and search the next upcoming cell.  At least for Rel-17, discontinuous coverage is not discussed for NR NTN. |
| Xiaomi | No | No |  |
| Intel | No | No | this optimization is not essential. |
| Apple | No | No |  |
| China Telecom | No | No | The stop time is enough. UE will find new cell by measurement results. |
| Spreadtrum | Maybe | No | If PCI of next cell is provided, cell reselection procedure is simple. |

**Question 5.2: If the timing information about new upcoming cell, e.g. the start time of new upcoming cell, is needed, how to provide such information to UE?**

|  |  |  |
| --- | --- | --- |
| Company | Fixed cell | Moving cell |
| Samsung | We just reuses the existing the stop time of the current serving cell but the information of incoming (serving) cell is needed. |  |
| Sony | NTN SIB |  |
| MediaTek | For Idle mode, the network can send it to UE only using SIB |  |
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## **Open issue 6: NW assistance information for SMTC adjustments in idle and inactive mode**

The following agreement has been made with an FFS left on the NW assistance information:

**RAN2#116bis-e**

1. Regarding UE-based solution for SMTC adjustments, UE autonomously adjust the SMTCs based on location and ephemeris. FFS whether NW assistance information is provided.

**Question 6: For UE-based SMTC adjustment in idle and inactive mode, in addition to the ephemeris, does UE need other assistance information provided from NW side? If Yes, what kind of assistance information is needed?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed comments on the required assistance information |
| Huawei, HiSilicon | No |  |
| Samsung | Yes | We think UE also needs feeder link delay information to determine propagation delay difference between the serving cell/satellite and neighbor cell/satellite. |
| CMCC | No |  |
| Lenovo, Motorola Mobility | No |  |
| Google | Yes | As the idle/inactive UE may not always have the ephemeris information of its neighboring cells and the access to UE’s location information, NW assistance information is helpful in SMTC adjustment. NW assistance information can be a drifting rate indicating the amount of time shift per time unit regarding the SMTC offset, a validity timer associated with an SMTC, or a start/end time pair associated with an SMTC. |
| Transsion | No |  |
| vivo | Yes | The delay of UE and serving/neighboring cell consists of service link delay and feeder link delay. But UE can only calculate service link delay based on UE location and ephemeris. So serving/neighbor cell’s feeder link delay are needed to calculate the delay difference between serving cell and neighbor cell. |
| Nokia | yes | we suggest broadcasting the threshold which will tell the UE when it shall shift the SMTC configuration and by how much (i.e. the size of such step). |
| Sony | No |  |
| MediaTek | No | Only neighbour cell ephemeris is required from the NW, which can be provided in SIB |
| Qualcomm | Yes | In addition to ephemeris, common TA parameters would be needed as the feeder link will be drifting at a rate, which could be 25us/s. The UE needs to know this rate. |
| CATT | No |  |
| Xiaomi | No | We already agreed that the feederlink delay can be compensated by network, |
| Intel | Yes | neighbour cell list associated to this satellite, and common TA. |
| Apple | No |  |
| Spreadtrum | Yes | Epoch time shall be provided with ephemeris information. |

## **Open issue 7: Enhancement on the SMTC broadcast for measurements in idle and inactive mode**

It has been proposed to enhance the SMTC configuration in idle and inactive mode by configuring up to 4 SMTC per frequency. There has been some discussion but no consensus was reached in RAN2#116bis-e.

**Question 7: Do companies see the need to enhance the SMTC broadcast for measurements in idle and inactive mode? If Yes, what is the expected enhancement?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Expected enhancement on SMTC configuration in idle and inactive mode |
| Huawei, HiSilicon | Yes | No strong view, 4 is ok |
| Samsung | No strong view |  |
| Lenovo, Motorola Mobility | No strong view |  |
| Google | Yes | Similar to the SMTCs configured in the measObjectNR, multiple (up to four) SMTCs can be broadcasted in the system information. |
| Transsion | Yes |  |
| vivo | No | Since UE autonomously adjusts the SMTCs based on location and ephemeris in idle and inactive mode, only one SMTC per frequency is already sufficient, the rest is left to the autonomous adjustment by the UE itself. If multiple SMTC configurations are provided, which one does UE choose to adjust? Also, unlike the RRC connected case, the NW does not know the real location of an IDLE UE, thus unable to estimate the serving link delay being actually experienced by the UE, so it is unclear how the NW configures the specific multiple SMTC values at a cell level. |
| Nokia |  | We think up to 4 is OK, but a lower number could be also enough for the same frequency. |
| Sony | No |  |
| MediaTek | No | Enhancements should be kept for future releases. |
| Qualcomm | Yes | But here more important is to track the timing offset of neighbor cell SMTC for which common TA parameters are needed.  The SMTC in the SIB should be based on cell reference location. |
| CATT | No strong view |  |
| Xiaomi | No |  |
| Intel | No | it can be left up to UE implementation to adjust SMTCs. |
| Apple | No | 4 is too many; In idle mode UE will anyways adjust SMTC based on need and there is no need for configuring too many. |
| Spreadtrum | No | It is up to UE implementation. |

## **Open issue 8: Enhancement on TN prioritization over NTN**

The following options have been raised in the past discussions on how to prioritize TN over NTN:

* Option 1: It is “hard” coded in the specification, e.g. in 38.304, that UE always prioritizes TN cell in cell reselection.
* Option 2: Indicate in system information of TN or NTN cell or both explicitly, the need to prioritize TN in the area the NTN/TN cells are covering.
* Option 3: Broadcast in system information a TN or NTN specific offset to be applied to RSRP measurement result for cell quality so that TN cell will always rank higher.
* Option 4: UE’s relaxed measurement mode is impacted to prioritize TN. For example, if UE detects TN cell UE stops any relaxed measurement mode for TN UE might have applied.

**Question 8: Do companies see the need to enhance cell reselection procedure to support TN prioritization over NTN? If Yes, which option do companies prefer?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | If Yes, option 1/2/3/4 or other |
| Huawei, HiSilicon | No | Can be postponed to future releases. |
| Samsung | See comment | Do we consider TN and NTN cells in a given carrier/band? If so, we think option2 otherwise no need of enhancement since cell reselection priority can prioritize TN carrier/band. |
| CMCC | other | RAN2 is difficult to converge to a specific solution given the limited time left in Rel-17. Moreover, legacy prioritization (carrier frequency based) is basically enough in Rel-17. Specifically, the priority configuration for inter-frequency cell reselection and the Qoffset and Qhyst for intra-frequency cell reselection can be utilized to prioritise TN over NTN as the legacy priority-based mechanism with the consideration of scenario characteristics, policies of different operators and service requirements.  Even the issue that raised above that the NTN cells have a large coverage, which results in the distance to the TN neighbours cells from the serving cell is deviated from different UEs, from our perspective, this can be addressed by the existing UE-specific signalling conveying frequency priority. Therefore, we prefer that TN prioritization over NTN IoT is left to NW implementation in Rel-17**.** |
| Lenovo, Motorola Mobility | No | This is not essential and we can consider in future releases. |
| Google | No | Due to the time constraint, this issue can be postponed to Rel-18. |
| Transsion | No | Legacy priority cell reselection should be enough. For specific case, it can left to next release. |
| vivo | No |  |
| Nokia | None | None of the above options is needed in Rel-17. |
| Sony | Yes | Option 2. We think the indication is applied to neighbour cells. |
| MediaTek | No | Existing priorities of inter-frequency cell reselection can be used to achieve this. |
| Qualcomm | Yes | TN and NTN bands are overlapping. But we agree existing mechanism can be used to prioritize TN over NTN. |
| CATT | No | Can be discussed in future release. |
| Xiaomi | No |  |
| Intel | none | no further spec change is needed to support prioritized TN over NTN. |
| Apple | No | No additional mechanism is needed for Release 17. |
| China Telecom | No | We recommend to consider it in the future release. |
| Spreadtrum | No | The existing of SIB X may indicate the NTN cell. It is not needed to introduce other rule to prioritize TN over NTN. |

## **Open issue 9: Prevent non-NTN capable UEs from accessing an NTN cell**

RAN4 has agreed to introduce new frequency bands for NR NTN due to the different frequency allocations for different services based on the ITU radio regulation. With such agreement in RAN4, UE would be aware the serving cell is a NTN cell or not based on the broadcast band information.

However, more frequency bands would be introduced in the future for NTN. The rapporteur understand RAN4 cannot give a promise that there will never be overlapping between TN and NTN frequency bands. With such thinking, we still need to consider whether a specific flag or mechanism is needed in RAN2 to prevent non-NTN capable UE from accessing an NTN cell.

**Question 9: Do companies see the need to define a mechanism in RAN2 to prevent non-NTN capable UE from accessing an NTN cell? If Yes, what would be the expected enhancement?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | If Yes, the expected enhancement |
| Huawei, HiSilicon | Yes | For non-NTN capable UEs, cellReservedForOtherUse IE and cellReservedForFutureUse-r16 IE in SIB1 can be set true. For NTN capable UEs, cellReservedForOtherUse IE and cellReservedForFutureUse-r16 IE should be ignored, and a new IE should be introduced in SIB1, e.g., cellReservedForFutureUse-r17. |
| Samsung | See comment | Do we consider TN and NTN cells in a given carrier/band? If so, we think indication of TN/NTN cell in the system information is needed, otherwise no need of enhancement since dedicated cell reselection priority will not include the TN carrier/band for non-TN capable UE. |
| CMCC | Yes | From our perspective, there is no need to limit the TN and NTN bands deployment. Moreover, it is about a just one single bit in SIB1 which will address the issue. As proposed before, for non-NTN capable UEs, cellReservedForOtherUse IE and cellReservedForFutureUse-r16 IE in SIB1 can be set true, whereas the NTN capable UEs will ignore the cellReservedForOtherUse IE and cellReservedForFutureUse-r16 IE and check a new IE should be introduced in SIB1, e.g., cellReservedForFutureUse-r17, which is very similar to what we specified in Rel-16 NPN. |
| Lenovo, Motorola Mobility | Open | We are open to discuss this but we also think it may not be that essential in this release, as for now NTN and TN have no overlap in frequency. |
| Google | No | Since RAN4 already agreed to introduce new frequency bands for NR NTN, we do not see an immediate risk of having overlapped frequencies between TN and NTN. Therefore, we prefer to not handle this issue in this release. |
| Transsion | Yes | Regarding TN and NTN frequency will overlap and NTN specific SIB  ,SIBx, will be scheduled1 by SIB1, RAN#2 can introduce new indication in MIB or SIB1 to indicate cell type. |
| vivo | Yes | Agree with Huawei, cellReservedForOtherUse IE and cellReservedForFutureUse-r16 IE in SIB1 can be used.  When cellReservedForOtherUse and cellReservedForFutureUse-r16 are set to true, all NTN-capable UEs shall treat this cell as candidate during the cell selection and cell reselection procedures; other UEs (i.e., R17 non-NTN capable UEs, R16 UEs and R15 UEs) shall treat this cell as if cell status is "barred".  Since the cellReservedForFutureUse-r16 is now occupied for a specific use, a new IE e.g., cellReservedForFutureUse-r17, should be introduced to play the role of barring the access of any R17 UEs to the cell. |
| Nokia | No | We think this may be addressed later, in next releases, when the problem (due to band overlapping) will become true. If new frequency bands are kept for NTN, currently no necessity to address this case. |
| Sony | Open | We are open to discuss but don’t think this enhancement is essential. |
| MediaTek | No | The frequencies of TN and NTN are different (as of now). When more frequency bands are introduced in the future, we can discuss on it. |
| Qualcomm | Yes | TN and NTN bands are overlapping according to RAN4 agreement. So its better and clear to introduce a new barring bit similar to what many companies are agreeing to do for IoT NTN.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | NTN satellite*band #* | Uplink (UL) *operating band* Satellite Access Node receive / UE transmit  FUL,low – FUL,high | Downlink (DL) *operating band* Satellite Access Node transmit / UE receive  FDL,low – FDL,high | Duplex mode | Corresponding TN band | | n255 | 1626.5 MHz – 1660.5 MHz | 1525 MHz – 1559 MHz | FDD | n24: UL: 1626.5 MHz – 1660.5 MHz; DL: 1525 MHz – 1559 | | n256 | 1980 MHz – 2010 MHz | 2170 MHz – 2200 MHz | FDD | n65: UL: 1920-2010; DL: 2110-2200 | |
| CATT | No | We assume the specific frequency will be used for NTN system in R17. If needed, it can be discussed in future release. |
| Xiaomi | No | We can address it in the future release if there is a problem due to band overlapping. |
| Intel | Yes | similar approach can be adopted like IoT NTN |
| Apple | No | Even if the bands are overlapping, the important point is that they are distinct and can be used to distinguish between TN and NTN. In the unlikely event that this distinction is not kept in the future, we can change the spec at that stage. |
| China Telecom | No | Maybe in the future release. |
| Spreadtrum | Yes | The existing of SIB X indicates the NTN cell. |

## **Open issue 10: UE awareness of whether an NTN cell is quasi-fixed or earth moving**

**Question 10.1: Do companies see the need for UE to be aware of whether the serving cell and/or neighbour cell is a quasi-fixed or earth moving cell? If Yes, what is the use case?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | If Yes, what is the use case? |
| Huawei, HiSilicon | Yes | If the cell is a moving cell, UE may need to predict the reference location by combing the moving trajectory and the coverage information, in order to perform location-based reselection (if RAN2 agrees location-based reselection is also applied to moving cell) or location-based CHO. |
| Samsung | See comments | We’re still not clear how earth moving cell works. By the way, do we consider for a given carrier/band, quasi-fixed cells and moving cells co-exist? |
| CMCC | No | UE can derive the cell type by the speed of PCI change or one cell coverage duration. |
| Lenovo, Motorola Mobility | See comments | We are not clear when UE needs to be aware of whether the serving cell and/or neighbour cell is a quasi-fixed or earth moving cell. But if needed, UE can derive from some configurations that are specific for one type cells, e.g. stop serving time or fixed reference location for quasi-fixed. |
| Google | Yes | Knowing this might be beneficial in determining when to trigger measurement and the candidate cell for cell reselection. |
| Transsion | See comments | RAN#2 should consider moving cell scenarios and usages first, it there is a new configuration is needed, then it can be used to indicate, implicit or explicit, cell type. |
| Vivo | No |  |
| Noki | No | It is perhaps not essential during the access, while it can be inferred shortly later, from the typical parameters for EMC/EFC. |
| Sony | No |  |
| MediaTek | No | Such use cases and optimizations are not needed in the first release. |
| Qualcomm | See comments | Cell stop time can indicate the cell is quasi earth fixed cell. Whether moving or fixed, what matters is how long UE can stay in the cell. |
| CATT | See comments | We wonder if there are some priority problems between earth fixed cell and earth moving cell, for earth fixed cell tends to provide a longer serving time. But the above mentioned problem seems can be solved by frequency priority and Qoffset. |
| Xiaomi | No |  |
| Intel | see comments | UE can know the type by the broadcast “t-service” in SIB, as it is only for quasi-fixed. |
| Apple | No |  |
| China Telecom | See comments | UE could deduce the type with SIB information. |
| Spreadtrum | Yes | If serving cell is fixed cell, the location based CHO or cell reselection is possible. |

**Question 10.2: How UE would be aware of whether the serving cell and/or the neighbour cell is a quasi-fixed or earth moving cell if such information is needed?**

|  |  |
| --- | --- |
| Company | Detailed comments |
| Huawei, HiSilicon | The indication is mainly useful for location-based CHO, it can be indicated to the UE through RRC message if the network wants to configure location-based CHO to the UE. |
| Lenovo, Motorola Mobility | If needed, UE can derive from some configurations that are specific for one type cells, e.g. stop serving time or fixed reference location for quasi-fixed. |
| Google | As the reference location is only broadcasted by the quasi-Earth fixed cell, UE can know whether a cell is a quasi-Earth fixed cell by checking whether this information is broadcasted in the system information. |
| MediaTek | Not needed at this point. |
| Intel | by the existence of “t-service” |
| China Telecom | Agree with Intel |
| Spreadtrum | Whether to exist the reference point or not in SIB X could indicate the fixed or moving cell. |
|  |  |
|  |  |
|  |  |

# 4 Conclusion

*To be added*

# Annex – Agreements for idle/inactive mode in NTN

## RAN2#111e

Agreements:

1. Cell selection / reselection in NR is the baseline in NTN idle mode procedure.
2. Satellite/HAPS ephemeris based cell selection and reselection should be defined for NTN (FFS what the term satellite/HAPS ephemeris actually means). FFS when this ephemeris based cell selection / reselection can be used. FFS whether UE location (and/or other information) based cell selection and reselection should be introduced for NTN
3. The satellite ephemeris should be provided to UE, at least for Satellite/HAPS ephemeris based cell selection and reselection (FFS what the term satellite/HAPS ephemeris actually means).
4. The network type (i.e. TN or NTN) should be known to UE. FFS whether to achieve this in an implicit or explicit way.
5. The existing cell reselection priority configuration can be taken as a baseline in NTN. FFS on any further enhancement.
6. Postpone the discussion on whether to introduce a new SIB until we have more progress on the content of NTN specific system information.

## RAN2#112e

Agreements:

1. Existing cell reselection principles are considered as baseline and that information about when a cell is going to stop serving the area and information about new upcoming cell can be further considered. In which form and how this is exactly implemented in the cell reselection principles is FFS.

## RAN2#113e

Agreements:

1. In NTN, the UE determines the TA based on the broadcast information (the use of other information is not excluded). In any case RAN2 will not go in a different direction than other groups
2. In NTN, the network may broadcast more than one TACs per PLMN in a cell, which is to up to network implementation.
3. The NTN ephemeris is divided into serving cell’s ephemeris and neighbour’s ephemeris. FFS how would they differ regarding e.g. the required accuracy or signalling impact.
4. Consider pre-configuration in uSIM, NAS, SIB and RRC signalling for providing the NTN ephemeris. Further discussion depends on the agreed ephemeris contents.
5. RAN2 thinks that a UE needs to know whether the network is a TN or NTN no later than SIB1 reception
6. The information on when a cell is going to stop serving the area and/or the timing information (e.g. timer or absolute time) about new upcoming cell is supported at least in Earth-fixed NTN scenario. FFS if both types of information are needed. FFS if this is known from system information and/or the ephemeris.

## RAN2#114e

Agreements:

1. At least in the quasi-earth fixed case (FFS for moving case), the timing information on when a cell is going to stop serving the area is needed to assist cell reselection in NTN for earth fixed scenario.
2. At least in the quasi-earth fixed case (FFS for moving case), the timing information on when a cell is going to stop serving the area is used to decide when to perform measurement on neighbor cells.
3. At least in the quasi-earth fixed case (FFS for moving case), the timing information on when a cell is going to stop serving the area for earth fixed scenario is broadcast to UE via system information.

## RAN2#115e

Agreements via email - from offline 108:

1. Broadcast of cell stop time in SIB is only applicable to quasi earth fixed cell (not to moving cell). No further work in this release to address any moving cell specific details on using the cell stop time to assist measurements or cell reselection
2. For quasi-earth fixed cell, the reference location of the cell (serving cell or the neighbor cells) is broadcast in system information
3. For quasi-earth fixed cell, UE should start measurements on neighbour cells before the serving cell stops covering the current area.
4. For quasi-earth fixed cell, the broadcast “timing information on when a cell is going to stop serving the area” refers to the time when a cell stops covering the current area.
5. For quasi-earth fixed cell, specify that UE should start measurements on neighbour cells before the broadcast stop time of the serving cell, i.e. the time when the serving cell stops covering the current area, and the exact time to start measurements is up to UE implementation.

Working Assumption:

Location assisted cell reselection, with the distance between UE and the reference location of the cell (serving cell and/or neighbor cell) taken into account, is supported for quasi-earth fixed cell, if UE has valid location information, which means location acquisition will not be triggered at UE side only for location assisted cell reselection. FFS on the details.

## RAN2#116e

Agreements:

Location assisted cell reselection, with the distance between UE and the reference location of the cell (serving cell and/or neighbor cell) taken into account, is supported for quasi-earth fixed cell. FFS on how UE performs location acquisition.

Agreements via email - from offline 102:

1. When UE uses location based cell reselection enhancements, it's up to UE implementation to guarantee that a valid location information is available

2. For quasi-earth fixed cell, same as legacy, UE shall perform neighbour cell measurements of “higher priority NR inter-frequency or inter-RAT frequencies” regardless of the distance between UE and serving cell reference location.

Agreements via email - from offline 102 - second round:

For quasi-earth fixed cell, UE should start measurements on neighbour cells before the serving cell stops covering the current area, regardless of (the distance between UE and serving cell reference location) or (if legacy Srxlev/Squal condition is met, i.e., serving cell’s Srxlev/Squal is better than a threshold).

Agreements online:

Distance based cell reselection criteria for quasi-earth fixed cell is supported

For quasi-earth fixed cell, the cell stop time of neighbour cell(s) is NOT broadcast

## RAN2#116bis-e

Agreements:

1. A new NTN-specific SIB is introduced (SIBx), scheduled by SIB1

2. Introduce the following serving cell information to the corresponding SIBx (scheduled by SIB1):

- Ephemeris;

- common TA parameters;

- validity duration for UL sync information;

- t-Service;

- cell reference location;

- Epoch time.

Also send a LS to RAN1 asking whether some parameters might be sent more frequently.

1. For quasi-earth fixed cell, same as legacy, UE shall perform neighbour cell measurements of “higher priority NR inter-frequency or inter-RAT frequencies” regardless of the remaining serving time.

5. RRC\_INACTIVE mode is supported for NTN.

Agreements via email - from offline 102 - second round:

1. Regarding UE-based solution for SMTC adjustments, UE autonomously adjust the SMTCs based on location and ephemeris. FFS whether NW assistance information is provided.

2. UE can know the NW type implicitly no later than SIB1 reception, there is no explicit NW type indication in SIB1.

3. No LS is sent to RAN3 on the support of RRC\_INACTIVE.

Agreements via email - from offline 103 - third round

1. Update of ephemeris and common TA information does not affect the value tag and does not trigger SI modification procedure.

2. The ntnUlSyncValidityDuration applies to the whole SIBX. UE acquires the updated SIBX when the timer expires. FFS whether to also include it in the LS to RAN1. FFS if this applies only to Connected mode or to idle mode UE as well

3. Location information can be used to determine when to start measurement.

4. UE may choose not to perform neighbour cell measurements of “NR intra-freq or inter-freq with equal or lower priority, or inter-RAT freq with lower priority”, if (the distance between UE and serving cell reference location is shorter than a threshold) and (legacy Srxlev/Squal condition is met, i.e., serving cell’s Srxlev/Squal is better than a threshold).

5. Location-based measurement initiation is only applied if the cell broadcasts location-related parameters (e.g. a threshold) and by implementation the UE has location information.

6. Before the stop-time based measurements are triggered, the UE measurements follow Legacy behaviour (i.e., based on Srxlev/Squal) and there is no measurement relaxation.

7. Cell stop time is not applied to cell ranking in determining the target cell for reselection.