3GPP TSG-RAN WG2 Meeting #113 draftR2-2102015

Elbonia, Online, 25 January – 5 February 2021

**Agenda item: 8.10.3.2**

**Source: Nokia, Nokia Shanghai Bell**

**Title: Report from [113-e][105][NTN] Idle mode aspects (Nokia)**

**WID/SID: NR\_NTN\_solutions-Core - Release 17**

**Document for: Discussion and Decision**

# 1 Brief scope of the paper

This document aims at collecting companies’ views regarding the Rel-17 NTN Idle mode:

* [AT113-e][105][NTN] Idle mode aspects (Nokia)

Scope: Discuss:

1. Continue the discussion on P1 and P2 from [R2-2100527](file:///C:\Data\3GPP\Extracts\R2-2100527_Report%20from%20%5bPost112-e%5d%5b153%5d%5bNTN%5d%20Idle%20mode%20aspects%20(Nokia).docx)
2. Usage and provision of the cell expire time and upcoming cell info
3. ephemeris assisted cell (re)selection

based on the corresponding proposals in [R2-2100347](file:///C:\Data\3GPP\Extracts\R2-2100347%20NTN%20Idle%20mode.docx) (P1~P4), [R2-2101196](file:///C:\Data\3GPP\Extracts\R2-2101196_Discussion%20on%20cell%20selection%20and%20reselection%20in%20NTN.docx), [R2-2100382](file:///C:\Data\3GPP\Extracts\R2-2100382.docx) (P1) and [R2-2100163](file:///C:\Data\3GPP\Extracts\R2-2100163%20NTN%20Idle%20inactive%20mode%20procedures.doc) (P1 and P2)

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): Monday 2021-02-01 17:00 UTC

Initial deadline (for rapporteur's summary in R2-2102015): Monday 2021-02-01 23:00 UTC

Proposals marked "for agreement" in R2-2102015 not challenged until Tuesday 2020-02-02 11:00 UTC will be declared as agreed by the session chair. For the rest the discussion will continue online.

The following sections elaborate on the topics listed in the scope above.

# 2 Proposal 1 and Proposal 2 from R2-2100527

As an outcome of [1] the following was proposed, among the others:

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| Proposal 1: UE is made aware of the network type (TN or NTN) in an implicit way.  Proposal 2: NTN scenario information (e.g. LEO/GEO) is not signalled explicitly, but inferred from the contents of the ephemeris. FFS which exact parameters are sufficient and whether this behavior needs to be specified. |

During the online discussion at RAN2#113, the following views have been exchanged with regards to these:

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| Proposal 1: UE is made aware of the network type (TN or NTN) in an implicit way.   * ZTE is fine for the serving cell but we could have an explicit indication for the neighbour cell. * LG still wonders whether this works. * Continue the discussion as part of offline 105   Proposal 2: NTN scenario information (e.g. LEO/GEO) is not signalled explicitly, but inferred from the contents of the ephemeris. FFS which exact parameters are sufficient and whether this behavior needs to be specified.   * Samsung/QC prefer an explicit indication to avoid that the UE needs to derive this. * Continue the discussion as part of offline 105 |

Despite large majority supporting each of these proposals during [1], it was not feasible to converge during the online handling of the resulting report [1]. Regarding Proposal 1, it is commonly understood there are multiple ways how this can be ensured, even if separate PLMNs for TN and NTN cannot be guaranteed (as argued e.g. by LG or BT [1]). For example, the existence of NTN-specific SIB or ephemeris is an easy way to infer the cell is of NTN type. In addition, we believe the introduction of a new parameter (network type in this case) shall be properly justified, so the proponents of an explicit indication shall actually describe why this is needed. Otherwise, before convincing the substantial majority, RAN2 shall proceed towards the end of the WI with the agreement there is no such explicit indication (as the need for having such new parameter has not been widely acknowledged).

As pointed out by ZTE and quoted in the box above, there may be a distinction between the serving cell and the neighbours as the UE may not know which SIBs are available per each neighbour cell, while it will anyway acquire serving cell’s SIB1 and know if e.g. NTN-specific SIB is available. Thus, it shall be considered whether we can at least agree no indication for the serving cell (i.e. in MIB/SIB1) is needed?

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| **Question 1: Do you agree there is no explicit indication of network type (TN/NTN) for serving cell in MIB/SIB1?** | | |
| **Company** | **Yes/No** | **Motivation** |
| Ericsson |  | For us it is hard to understand why this explicit/implicit indication discussion is taken in the beginning of the release when we have almost no knowledge how the SI will look in the end. As we have commented, we should see towards the end of the release, are we missing a needed indication or not. If we are missing an indication that has a use case (with consensus), it should be added. |
| MediaTek | Yes | It could be implicitly indicated. |
| Qualcomm | Yes | There is no need to introduce explicit indication. This is about identifying sooner from MIB vs identifying later from SIB1. Identifying NTN cell sooner the better to reduce RRM impact. We should send LS to RAN1 for NTN specific MIB. |
| Samsung | No | There could be different definitions of “NTN Type.” In the simplest definition, “NTN Type” can simply differentiate between a TN and an NTN. In another definition, it can distinguish among different NTN platforms such as GEO, MEO, LEO, and HAPS in addition to a TN. A yet another definition can indicate the beam type. Indeed, several companies had mentioned their preference for broadcasting a beam type.  Hence, as a potential way forward, SIB1 can use 2-3 bits to convey both the platform type and the beam type (e.g., GEO, HAPS, LEO with Quasi-Earth-Fixed Beam, LEO with Earth-Moving Beams, and so on.).  Benefits of “NTN Type”:  An explicit broadcast of “NTN Type” avoids the need for the UE to process any NTN-specific SIBs just to find that the NTN Type that it has discovered has a lower priority and that it would need to look for another cell.  The criteria for the cell reselection process are quite different for different types of beams (e.g., Earth-fixed beams vs. Earth-moving beams). A compact NTN Type indication will enable the UE to start using relevant criteria for cell selection and reselection.  An operator can prioritize the selection of an NTN Type for its UEs. An NTN can be prioritized over a TN (and vice versa). For example, a HAPS operator can prioritize an NTN over a TN, while a TN operator can prioritize a TN over an NTN. An explicit “NTN Type” enables the UE to complete the network selection quickly.  Additionally, an NTN operator may have different priorities for GEOs vs. LEOs. Having an explicit NTN Type reduces the amount of processing that the UE needs to do for the network selection.  We observe that PLMN ID cannot be used to imply a TN vs. NTN, because it is entirely possible that the same PLMN supports both a TN and an NTN.  Although the NTN platform type (e.g., GEO vs. LEO) can be inferred by the UE after processing a SIB containing such ephemeris, beam type is not present in the typical ephemeris data.  We also see the benefit of specifying the NTN Type for neighbor cells in addition to the serving cell.  In our view, if we invest a couple of bits in defining “NTN Type,” it will simplify the UE processing and provide flexibility to operators.  We also note that defining an “NTN Type” in RAN will also help the Core Network.  The UE can include the standardized “NTN Type” detected in a SIB in a NAS message such as Registration Request so that the AMF can accept/reject the UE’s registration request based on the  The AMF can use the NTN Type to optimize the paging operation (e.g., by selecting the paging retry timer).  Additionally, the NTN Type, similar to the RAT Type, can be used for charging (e.g., one set of charging characteristics for the TN and another set of charging characteristics for an NTN/NTN Type).  The NTN Type can be used by the gNB to select the AMF that is customized to serve NTN UEs. The AMF can use the NTN Type to select an SMF. |
| Lenovo | Yes | It can be implicitly indicated e.g. by presence of ephemeris. |
| Spreadtrum | Yes | Many parameters could be used to indicate NTN/TN cell type implicitly, e.g. ephemeris, common RTD, TA drift rate. |
| OPPO | Yes |  |
| Xiaomi | Yes | As pervious discussion, there are many implicit solutions to indicate network type. |
| CMCC | Yes | Satellite ephemeris is enough. |
| ZTE | Yes |  |
| APT | Yes | Share QC’s view.  Send an LS to RAN1 for NTN specific MIB. The rest of the solutions have been discussed in both RAN1/2, but the new MIB sequence would still need some discussion. |
| Sony | Yes |  |
| LG | No | We still think the suggested parameters for implicit network type indication is not enough, because the UE always should be able to distinguish the network type but these information cannot not guarantee yet.  However, we can postpone this issue to later as Ericsson commented. |
| InterDigital | Yes | Default assumption can be implicit. There are many things to be agreed first (e.g. existence of an NTN-specific MIB/SIB, format of ephemeris data etc) before considering if an explicit indication is necessary. |
| Huawei, HiSilicon | No | It’s too early to exclude explicit indication. We are fine with UE can be aware of network type in an implicit way, e.g. by ephemeris data. But currently we are not sure if a NTN specific SIB will be introduced, and we haven’t discussed about where to put this ephemeris data either. So our concern is that UE may derive this NTN network type too late, if the ephemeris data is not in MIB/SIB1 in the end. |
| Apple | No | Only if entire satellite ephemeris is present at the UE an explicit indication can be avoided. Otherwise, an explicit indication is needed in case the network is indicating it through SIB/MIB. Either way it is too early to have an agreement on this before deciding how ephemeris itself looks and what in ephemeris is going to be provided with what accuracy. |
| Rakuten Mobile | - | This is not important at this point and can be taken up later. |
| CATT | Yes |  |
| Intel | No | We do prefer explicit indication. |
| ITRI |  | Agree with Qualcomm that the consideration is to identify TN/NTN from MIB or SIB1.  Also it’s not clear to us what explicit/implicit mean. From our point of view, it is “explicit indication” if NTN-specific information (i.e., the information would not be provided for TN cells) is provided. |

Summary for Question 1:

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Then, a related question shall be asked concerning the neighbour cells, as suggested by ZTE. It is argued [1] that SIBs 2-5, where the cell reselection information could be provided, there is a need to indicate which cells are of NTN type, so that the UE knows which cells to consider in reselection process. As this is related to cell reselection procedure (discussed separately below) and also such information can be conveyed in the ephemeris (when its content are decided eventually), we think it is perhaps not essential to consider it here and now. On the other hand, for completeness (with Question 1), companies are at least asked to indicate if NTN type for neighbour cells shall be indicated explicitly. If yes, please indicate how. If not, please indicate why.

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| **Question 2: Should the network type (NTN or TN) be indicated explicitly for neighbour cells? If yes, please indicate how. If not, please indicate why.** | | |
| **Company** | **Yes/No** | **Motivation** |
| Ericsson |  | Instead of asking about the indication for which the discussion is way too early, the question should be about the functionality of cell reselection. Should cell reselection take into account NTN/TN or NTN type and is so how would it work and how does it improve the cell reselection process. Without this understanding the discussion on should we agree on indication or not is waist of time. It cannot be concluded without understanding how it is used. |
| MediaTek | No (for now) | UE should be able to identify the NTN neighbour cells by using the ephemeris information. We can revisit it once the ephemeris details are agreed upon. |
| Qualcomm | No | If we agree NTN specific MIB, UE can simply identify the NTN cell from SSB (no further SI acquisition needed). |
| Samsung | Yes | An explicit indication of the NTN Type (including the platform type such as GEO/LEO) would be helpful in cell reselection by prioritizing one NTN Type over another (or a TN vs. an NTN).  The NTN Type indication for the serving cell is useful for cell or network selection and the NTN Type indication in neighboring cells is useful for cell reselection (or combined cell reselection and network selection). |
| Lenovo | No | It can be implicitly indicated e.g. by presence of ephemeris. |
| Spreadtrum | No | The type of neighbour cell could be indicated implicitly by ephemeris. |
| OPPO | No (for now) | Agree with MediaTek. |
| BT | Neutral | It is important for BT that the UE can reselect into a TN or into a NTN independently of its current connected network where TN 🡪 TN reselection is the legacy.  We don’t have strong preference for explicit or implicit even explicit looks simpler. |
| Xiaomi | No | We agree with MdediaTek, |
| CMCC | No | Pls. see our comment to Q1. |
| ZTE | See comments | We understand it is also related to how we would model the idle mode mobility between TN and NTN as SA1 has introduce a Access Technology identifier (i.e. satellite NG-RAN) for NTN with an LS sent to the RAN plenary(S1-204379). SA2 is considering to define more RAT types, e.g. NR (LEO), NR (MEO), NR (GEO), NR (OTHERSAT) to differentiate QoS for satellite/HAPS access in different orbits.  As we discussed in R2-2101201, from RAN2’s perspective, it is worth considering whether we will also treat NG-RAN satellite access as a separate RAT from NG-RAN in mobility handling in idle and connected mode.  Treating the mobility between a NR-NTN cell and NR-TN cell as intra-RAT or inter-RAT mobility will lead the discussion into two different directions, introducing different changes on the existing specifications.  For example, if cell reselection between a NR-TN cell and a NR-NTN cell is considered as inter-RAT cell reselection. The content for SIB2-5 would look like the following:    As a contrast, if the between a NR-TN cell and a NR-NTN cell is considered as intra-RAT cell reselection. The content for SIB2-5 would look like the following:    Since this discussion is related to TN-NTN mobility, we are also fine to suspend the discussion this meeting and come back to this later when more progress has been made for intra-NTN cell (re)selection. |
| APT | No | Agree with Ericsson. Ephemeris only provides satellite information. Not sure why UE may benefit from identifying neighbour cells. |
| Sony | Yes | We agree with ZTE that the main use case is for the mobility between TN and NTN. According to the radio propagation characteristics of a satellite signal, the radio link quality of a satellite cell is relatively low compared with that of a terrestrial cell and such indication about neighbour cell would be useful. |
| LG | Not now | We are discussing contents of ephemeris information how to provide neighbour LEO satellite information. So when contents of ephemeris information is concluded, we can discuss whether network type indication of neighbour cell is needed in addition to the ephemeris information. |
| InterDigital | Postpone | Agree with rapporteur this doesn’t need to be considered now. In our view this discussion primarily relates to NTN-TN idle mobility, which hasn’t been discussed yet. |
| Huawei, HiSilicon | Postpone | When we have clear understanding on idle procedure in NTN and ephemeris format, we can revisit this discussion point. |
| Apple | Postpone | As was commented by us in the online session and our comments taken back due to following majority, we first need information from RAN1 on what the ephemeris information, data formats and accuracy needed is before we can proceed whether serving and neighbor cells information is to be provided in SIBs. We prefer the entire ephemeris data be sent to the UE instead of wasting bandwidth in indicating serving and neighbor cells. We prefer to look at pre-provisioning mechanisms in more details before we can decide on this topic. |
| Rakuten Mobile | Postpone | As other companies commented, this discussion can be taken up when other details like Ephemeris, MIB/SIB Format and NTN RAT type is finalized. |
| CATT | No (for now) | Agree with MediaTek |
| Intel | Yes | 1 bit per neighbouring cell can be indicated to the UE. Otherwise it may be difficult for UE to figure it out via implicit indication. |
| ITRI | No | The serving cell could prioritize and arrange the neighbour frequencies for cell reselection. In case TN/NTN share the same frequency, UE could utilize ephemeris information to distinguish TN/NTN cell. |

Summary for Question 2:

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Regarding Proposal 2 (*NTN scenario information (e.g. LEO/GEO) is not signalled explicitly, but inferred from the contents of the ephemeris. FFS which exact parameters are sufficient and whether this behavior needs to be specified*), we would like to highlight there was a massive support for such approach in [1], namely 24 out of 26 companies were OK to progress with no explicit signalling of NTN scenario type. As described in [1], there are numerous ways to distinguish the scenarios, based on some scenario-specific parameters (such as compensation values, etc.) or contents of the ephemeris. Even if the ephemeris for neighbour cells will be of reduced size and limited in detail, compared to the serving cell’s ephemeris, it shall still be sufficient to recognize the scenario and allow the UE to identify if the cell is e.g. LEO or GEO. Furthermore, the usual approach shall be to confirm the issue and convince all RAN2 companies new parameter(s) for such indication is/are needed. So far, based on [1] and related discussions, the overwhelming majority in RAN2 believes the UE can recognize the scenario in multiple ways. Thus, we suggest RAN2 proceeds with such agreement for the time being and revise it only if during the remainder of the WI it is identified and proven implicit indication is insufficient.

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| **Question 3: Do you agree implicit indication of NTN scenario is enough for Rel-17 work? It can be revised if during the remainder of the WI it is proven implicit indication is not sufficient.** | | |
| **Company** | **Yes/No** | **Motivation** |
| Ericsson |  | What does the question mean? Implicit implication enough for what? How can we know at early release if it is enough for Rel-17 when we do not know what will be in Rel-17??  We should discuss per functionality that how and if cell reselection or cell selection is improved or not. If we improve it in a decided way, RAN2 should agree on the needed signalling support. |
| MediaTek | Yes |  |
| Qualcomm | Yes | See response in Q1. Obviously if we found later explicit indication is also needed, we can consider introducing one. |
| Samsung | Pl. see “Motivation” | If the goal is to identify the NTN Type, processing an early (i.e., in SIB1) and compact (i.e., just 2-3 bits) explicit indication of the NTN Type is much more efficient in our view. Processing the platform ephemeris and comparing the ephemeris data with suitable thresholds for different platforms (e.g., HAPS, LEO, and GEO) would need more processing time and consume more UE battery power when the goal is to simply identify the NTN Type.  We reiterate that an explicit indication is not expensive from the signaling perspective; the indication would take only 2-3 bits depending on exactly what the indication represents.  Can we please explore the support for the following statement?  “Use 2-3 bits in SIB1 to explicitly convey the NTN Type including the beam type.” |
| Lenovo | Yes | For now we think ephemeris could do the work, and revision can be made depending on the final format of ephemeris. |
| Spreadtrum | Yes | The ephemeris is enough for now. |
| OPPO | Yes | UE could always derive NTN scenario based on ephemeris. |
| Xiaomi | Yes |  |
| CMCC | Yes | We can come back to this if the final ephemeris format does not work well. However, from our perspective, it is sufficient to infer the NTN scenarios for now. |
| ZTE | Yes | * We understand if UE has preference for certain scenarios (e.g. prefer LEO over GEO), explicit indication in the reselection information for neighbor cells broadcast in system information would be helpful for UE to identify neighbor cells with preferred scenario exclude cells of no interest. * If UE is aware of the ephemeris of neighbor cells, the scenario info can also be inferred by UE.   Both options mentioned above are acceptable to us. |
| APT | Yes |  |
| Sony | Yes |  |
| LG | Maybe | In our contribution R2-2100578, we propose beam-specific information of LEO satellites. If beam-specific information is provided, it can implicitly indicate the scenario type. Presence of the information means the cell is LEO satellite, and the absence means GEO satellite cell. |
| InterDigital | Yes | Implicitly based on ephemeris is sufficient for now. Can of course be revisited once ephemeris format is concluded (if issues identified) |
| Huawei, HiSilicon | Yes for LEO/GEO type, but revisit it later on | We agree LEO/GEO type information can be inferred by ephemeris. But since there is no concrete understanding on ephemeris data, it should be open to revisit it later on. |
| Apple | Yes | Ephemeris should be sufficient for now. |
| Rakuten Mobile | Yes | Presence of Ephemeris info should be enough. |
| CATT | Yes |  |
| Intel | See comment | We do prefer explicit indication but ok if majority of the company prefer implicit. But should be revised when implicit is not workable at the end. |
| ITRI | Yes | Ephemeris should be sufficient to indicate NTN type implicitly. |

Summary for Question 3:

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# 3 Cell reselection related enhancements

Another part of this e-mail thread is to discuss the subset of proposals in [2][3][4][5] which are related to cell expiry time and upcoming cell info, to be used for cell (re)selection and other IDLE mode procedures. A related aspect is that such information, if agreed, could be provided via ephemeris. In [1] there were mixed views provided whether such timing information on when the cell is going to stop/another is going to start serving the area is essential for cell reselection, with a slight majority saying it is not needed. However, the level of interest in having such mechanism, based on the submitted papers, still appears to be quite high.

In [2] and [3] the authors suggest the awareness of cell expiry time shall be considered for cell selection/reselection and triggering the intra-frequency/inter-frequency measurements. Both papers argue RSRP/RSRQ measurements are insufficient for cell reselection and also suggest to consider UE’s location [2] or the distance between the UE and the satellite or cell center [3].

Even though lots of details in this area have been discussed multiple times (e.g. in [1]), we would like to make another attempt, with tiny step at a time and starting from a different angle.

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| **Question 4: Should the UE be provided with the information on when a cell is going to stop serving the area and the timing information about new upcoming cell? Please indicate how it is provided (e.g. system information, ephemeris, etc.)** | | |
| **Company** | **Yes/No** | **Motivation** |
| Ericsson | yes | It should be provided in system information. Whether this is in IE of system information that includes ephemeris and this info is part of that part of SI is stage 3 detail. We prefer to not to rely this information is part of preprovisioned ephemeris.  Reason to support it is that an idle mode UE may reselected the new cell while feeder/service link switch is ongoing. Otherwise, UE camping on cell that is going to disappear will at some point notice that its serving cell disaapeared and then reselected. While UE eventually finds the new cell like this as well, it will miss paging and UE initiated call will also start with a delay. It may e.g. happen that UE initiates a call via a cell that disappeares in the next moment e.g. during RACH process. |
| MediaTek | Yes | Long term ephemeris can be used to indicate it. |
| Qualcomm | Yes | The cell can broadcast cell expiry time and list of cells that will take over the area. This will reduce the interruption. |
| Samsung | Pl. see details in the next column. | We have observed that different types of beams would benefit from different triggers. For example, such expiry is only applicable to quasi-Earth-fixed beams. It is not suitable for Earth-fixed beams and Earth-moving beams.  Instead of restricting the discussion to only “serving time expiry,” we should discuss suitability of candidate standalone triggers and candidate combination triggers. The use of combination triggers (e.g., (i) RSRP and time and (ii) RSRP and a UE location-based trigger such as distance from the cell center) would lead to a more reliable cell reselection process.  Note that RAN2 has identified some combination triggers as part of CHO discussions. There could be synergy between idle mode triggers and connected mode/handover triggers. |
| Lenovo | Yes | As part of or along with ephemeris. |
| Spreadtrum | Partly Yes | For moving beam, UE could calculate the time of coming/leaving for a cell based on ephemeris, but for fixed beam, this information shall be indicated explicitly. |
| OPPO | No | We don’t see the need of providing such information to the UE for cell reselection.  For a UE in RRC IDLE state, the UE would detect the cell stopping serving the area based on measurement, so the information about when a cell is going to stop serving the area is not necessary, and how to search and camp on a new cell is up to UE implementation, so the information about new upcoming cell is also not needed. |
| BT | No for moving beams.  More evaluation for fix beams on Earth | It looks important than fix or moving beams are prioritized in RAN2 as they have different characteristics and therefore, different requirements.  For moving beams, broadcasted for all the UEs when a NTN cell is going to stop serving the area and the timing information about new upcoming cell makes no sense. It is completely dependant on the UE location, the cell size, the satellite high/speed, etc.  For fix beams, before we agree on that, it is important to understand the load introduced by this information and the periodicity it requires. Without that numbers, it is impossible to agree if this is a workable solution. |
| Xiaomi | Yes | We think it can be used for earth fixed beam scenario. |
| CMCC | Yes | Both SI and ephemeris are fine. However, it could not just rely on this as the cell reselection condition, the combination with RSRP/RSRQ and/or UE location information could be considered. |
| ZTE | Yes for cell expire time  No for upcoming cell information | * With awareness of the cell expire time of the camped cell and neighbor cells, idle mode UE may use it to drive the remaining valid time of the current cell or neighbor cells to decide whether to trigger intra-frequency/ inter-frequency measurements or to reselect a cell with longer valid time. Thus, we understand such information would be useful.   On provision of such information, there might be different handling for earth moving and earth fixed cells.   * + For moving cell, as shown below, the expire time of the current cell for UE in different area in this cell would be different, making it difficult to broadcast such information as the system information are broadcast per cell rather than per UE.   => One possible solution to let UE aware of the cell expire time is to **provide the cell deployment information of each satellite as part of ephemeris information** **and let UE derive the expire time of each cell.**     * For earth fixed cell, since the cell coverage can be relatively fixed on the ground, and the cell expire time would be the same for all the UEs under this cell, which is possible for network to **broadcast such information**. * Regarding the upcoming cell info, we do not see much benefit in providing it as the UE movement is not always predictable and the upcoming cell cannot simply be considered by UE as reselection target when the current cell expires. |
| APT | Yes | Good feature for earth fixed cells. Support this feature under a condition when the earth fixed beam scenario is deployed. |
| Sony | Yes | This information will allow the UE to decide when to perform cell reselection before the cell actually disappear and the coming cell information will be beneficial to make cell re-selection decision. It can be included in system information. |
| LG | Yes | As LEO satellites appear/disappear periodically with predictable path, periodicity and service duration time of each LEO satellite can be provided. Following table can be the example of the next cell list with periodicity and visible time of each cell, as described in R2-2100579:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Order | NTN Cell list  (Upper case: frequency, lower case: cell) | Start time (UTC) | Duration time | Periodicity | | #1 | A: a1, a2 | 9:00 | 15 minutes | 2 h | | #2 | B: b1, b2 | 9:10 | 10 minutes | 3 h | | #3 | C: c1 | 9:15 | 15 minutes | 2h 30min |   Once the next cell list is acquired, the UEs do not need to re-acquire the cell list information unless satellite deployment is changed. The UE can just repeat the measurement and cell reselection evaluation regularly.  Regarding ZTE’s comment the reason why upcoming cell info is not needed, we think UE’s movement is ignorable compared with cell coverage size and satellite movement speed. So even if the UE moves around, the cell list would not change so that the information is still useful. |
| InterDigital | Yes | Agree broadcasting both time remaining and upcoming cell information in SI would be useful in cell reselection for *earth fixed cells* or for *feeder-link switch*, where the cell will appear/disappear uniformly for all UEs within the cell.  Broadcasting this information will not work for earth moving cells as time the UE is within cell coverage will vary depending on UE location relative to cell centre. In this case other information such as cell centre coordinates might be required for UE to calculate |
| Huawei, HiSilicon | Partially yes | One concern is that the NTN physical cell is quite large, so the serving time for each UE differs a lot. If this kind of assistance information is needed, it should be provided with a finer granularity, but not a single value for the all UEs in this cell. |
| Apple | Partial yes | In the case the entire ephemeris is not present at the UE to derive this information on its own. In the case a SIB/MIB mechanism is used, this information is potentially useful depending on how the discussion for TACs and Cell IDs concludes. We agree with Samsung. |
| Rakuten Mobile | Yes & No | **For earth moving cells** It’s not clear how it can be useful when UE’s at different location of a cell will experience different serving cell time.  Can be used for earth fixed cells.  Broadcasting Upcoming cell information is useful, however; is not simple to realize as upcoming cell may depend upon UE location.  Serving satellite would need to broadcast multiple neighbours and it would be up to UE to select optimal cell. |
| CATT | No | In our understanding, it is unclear how to broadcast the timing information since UE in different location of the cell, the timing may be different. Since the feasibility and benefit of introducing this mechanism is unclear, it should not be introduced without justification. |
| Intel | No | We don’t think it is necessary for idle mode UE. Current cell reselection should be able to handle such situation. |
| ITRI | Yes | The time a NTN cell providing service to an area depends on feeder link switch. We agree at least the new coming cells should be provided to UE for starting measurements of interested frequencies/cells. |

Summary for Question 4:

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If you have answered ‘Yes’ to Question 4, please further indicate how such information is used (e.g. cell reselection, idle mode measurements triggering, etc.)

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| **Question 5: How is the information on when a cell is going to stop serving the area and the timing information about new upcoming cell used? E.g. for cell reselection, idle mode measurements triggering, etc. Please indicate also the applicable scenarios (e.g. Earth-moving, Earth-fixed cells).** | |
| **Company** | **Answer** |
| Ericsson | This is used for reselection such that when UE knows the service/feeder link switch is coming and new cell appeared, UE starts the corresponding measurements and cell reselection process.  This is mainly needed for Earth fixed cells but as per implementation it can be applied in Earth moving cells as well. |
| MediaTek | As this is for idle mode, how this information is used can be left to UE implementation. |
| Qualcomm | With cell expiry time, UE would know when to trigger cell reselection procedure even though signal strength from the service cell is good. With upcoming cell information, UE can prioritize to select that cell given it meets S-criteria for cell reselection.  This will reduce interruption. |
| Samsung | Please see our response to Question 4. Thanks. |
| Lenovo | UE may decide when to trigger neighboring measurement in advance or which cell to be prioritized for reselection based on the above information. |
| Spreadtrum | UE may determine when to measure the neighbour cell based on this assistant timing information. |
| Xiaomi | We think it can be used for earth fixed beam scenario.  UE can use the information to decide when to trigger neighbour cell measurement and which target cell should be measured with priority. |
| CMCC | With the mentioned information, the UE could implement measurement beforehand and select one better cell to camp. |
| ZTE | The cell expire time can be used by UE in the following cases:   * Trigger intra-frequency measurements or measurements on inter-frequency with an equal or lower reselection priority.   For example, a TIntraSearch and a TnonIntraSearch can be configured to UE. UE will start to perform intra-frequency measurements when the remaining valid time of the current cell Tremaining <= TIntraSearch before the Srxlev <= SIntraSearchP or SSqual <= SIntraSearchQ is fullfiled. Similarly, UE will start to perform measurments on inter-frequency with an equal or lower reselection priority when Tremaining <= TnonIntraSearch before the Srxlev <= SnonIntraSearchP or SSqual <= SnonIntraSearchQ is fullfiled.   * Help UE reselect a cell with longer valid time.   For example, a threshold of the remaining valid time together with adjustments on the R-value or reselection priority can be configured to UE, neighbour cells with remaining valid time longer than the threshold will get a bonus by improving the reselection priority or R-value with the adjustment factor configured.  To find a cell with high RSRP and longest valid time, a rangeToBestCellNTN can be configured. UE rank the neighbour cells based on the R-criterion while the cells whose R value is within range to best cell of the R value of the highest ranked cell will be considered as candidate cells. Among all these candidate cells, UE will reselect to the cell with longest valid time. |
| APT | Agree with MediaTek. Up to UE implementation. |
| Sony | For cell reselection, both earth-moving and earth-fixed cells. |
| LG | If next cell list is provided, based on appearance time of each cell, the UE can change its measurement target frequencies by time. Based on the measurement results, the UE can perform cell reselection evaluation. |
| InterDigital | Would allow idle UEs to prioritize (re)selection to cells with maximum time remaining, lowering frequency of cell reselection or for enabling measurement relaxation if UE will be served by cell for a (relatively) long time.  Could apply to both earth fixed and earth moving cells, however each would require a different method of determining time remaining for a cell (as mentioned in Q4 comments). |
| Huawei, HiSilicon | This is for idle mode procedures, both cell reselection and measurement for neighbour cells can be considered. |
| Apple | We think this information is useful for cell selection procedures as well and not just re-selections. We agree with Samsung’s response from Q4 that additional procedures need to be looked into as well that will be beneficial to UEs for cell reselections. |
| Rakuten Mobile | Same as Ericsson mentioned; Can be used for Earth fixed Cells. |
| ITRI | This would allow IDLE/INACTIVE UE to trigger cell reselection. UE could trigger neighbour cell search and measurements according to the starting service time of neighbour cells. Based on that, UE may reselect from the upcoming cells according to the frequency priority provided by the serving cell. |

Summary for Question 5:

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In each of the considered papers [2][3][4][5], the use of UE’s geolocation for IDLE mode procedures (such as cell reselection) is mentioned. It is either suggested on the general level [2] or with more detailed implementation details, such as using the distance between the UE and the satellite or cell center [3][4][5]. Companies are therefore asked to share their views whether UE’s geolocation shall be used for IDLE mode procedures and in what form.

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| **Question 6: Should the UE’s geolocation information be used for IDLE mode procedures? If yes, please indicate how is it used and for which procedures.** | | |
| **Company** | **Yes/No** | **Motivation** |
| Ericsson | yes | The idle mode measurement rules should be enhanced such that UE does not need to perform idle mode measurements if it is close to center of the cell(and the cell is not about to vanish). |
| MediaTek | No | It will have severe negative impacts on UE’s power consumption, which is the most important aspect in Idle mode. |
| Qualcomm | Yes | Triger of cell reselection procedure can be considered based on location.  Obviously, UE’s last calculated position should be considered to minimize the use of GNSS. Either UE speed can be ignored, or UE location can be updated periodically. |
| Samsung | Yes | We suggest that RAN2 evaluate candidate standalone triggers and candidate combination triggers as mentioned in our response to Question 4. The UE location can be used to determine the distance between the cell center and the UE and such distance can be a useful trigger. To address MediaTek’s power consumption concern, we can perhaps have a period between two successive location measurements. |
| Lenovo | Yes | Location can be used in a combined manner with legacy criteria (RSRP/RSRQ) in neighboring measurement triggering or cell ranking. |
| Spreadtrum | Yes | IDLE UE may decide the occasion to start measuring the neighbour cell based on Location information and ephemeris. |
| OPPO | Yes | UE could perform cell reselection based on both UE location information and RSRP measurement. More specifically, UE could firstly select N best cells using RSRP ranking and then among the N best cells, UE selects a target cell with the shortest distance to the cell center. Thus, cell center information should be broadcasted for each satellite. |
| BT | Tent to no | It doesn’t seem power efficient for the UE to measure its geolocation all the time it is in idle.  Not sure we agree with QC. We agree that in most cases, UE speed can be ignored but at the end, it depends on the scenario. |
| Xiaomi | Yes | UE can decides the target cells based on S criterion and R criterion, and then selects one target cell base on UE location and cell reference distance provided by network. For the cell reference distance, it can be the distance between the cell edge and the center of satellite beam footprint on earth, it implies the range that the network can provide the effective coverage. |
| CMCC | Yes | UE location information is helpful for cell reselection due to the unobvious near-far effect. In order to decrease energy consumption of the UEs, we could consider using GNSS to track the location of the UEs periodically instead of continuously tracking, with combining TA value, neighbouring PCI and other information to design the conditions for starting GNSS to save electricity. |
| ZTE | Yes | The following examples can be considered for the usage of UE location in cell (re)selection procedure:   * Example1: Configure a Threshold of the distance between UE and the satellite/cell center and only neighbor cells with distance shorter than the Threshold will be considered during cell selection or reselection. * Example 2: Configure a Threshold of the distance between UE and satellite/cell center along with an adjustment to the cell reselection priority or Qoffset. Cells with shorter distance between the serving satellite and UE will get a bonus in determination of the reselection priority or R-value calculation. * Example 3: Configure a rangeToBestCellNTN, cells with R-value within this range will be considered as candidate cells for reselection while UE will re-select to the cell with shortest distance between the serving satellite/cell center and UE. |
| APT | Prefer no | If yes, then a GNSS measurement period shall be considered. GNSS always on shall not be an option. |
| Sony | Yes | We also agree with companies above that geolocation information is beneficial for IDLE mode cell re-selection. |
| LG |  | We think UE location information-based idle mode mobility is not useful. The distance evaluation between the UE and satellite will increase UE power consumption greatly but the accuracy seems to be not really guaranteed. Especially in moving beam case, the satellite and cell coverage changes dynamically, so the location-based idle mobility will not effective. It may work in fixed beam case, but it is not desirable way to design different cell reselection rules for different beam types. |
| InterDigital | Yes for earth moving  FFS earth fixed | Primary use case would be to aid cell (re)selection/enable measurement relaxation.  For earth fixed scenario, network may be able to broadcast all information necessary (e.g. time remaining for cell) to enable UE actions like measurement relaxation. Minimized use of UE location would be beneficial from UE power saving perspective.  For earth moving, UE would need to do some calculation to cell centre to determine this value itself, so would need at least some knowledge of its location. |
| Huawei, HiSilicon | Yes | If the assistance information is provided with a finer granularity, UE should know which finer area it is located in, then it can choose which value is applied for itself. |
| Apple | No | Procedures involving frequent location checks on UE have severe power impacts. |
| Rakuten Mobile | Yes | The impact on power usage can be minimized with proper parameters.  Information can be used in cell selection and reselection. |
| CATT | Yes | The UE location information can be used for both IDLE mode measurement initiation and cell reselection determination. |
| Intel | Yes | UE location can help with cell reselection especially measurement when it is close to another cell. This will actually save UE power consumption. |
| ITRI | Yes | We agree that UE location is useful at least for IDLE/INACTIVE mode cell reselection. |

Summary for Question 6:

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# 4 Conclusions

Based on the views expressed in the previous sections, we propose the following:

Proposals

# 5 List of referenced documents

[1] [R2-2100527](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2100527.zip) *Report from [Post112-e][153][NTN] Idle mode aspects (Nokia)* 3GPP TSG-RAN WG2 Meeting #113 Electronic Elbonia, 25th of January – 5th of February 2021

[2] [R2-2100347](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2100347.zip) *Idle mode aspects for NTN* 3GPP TSG-RAN WG2 Meeting #113 Electronic Elbonia, 25th of January – 5th of February 2021

[3] [R2-2101196](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2101196.zip) *Discussion on cell selection and reselection in NTN* 3GPP TSG-RAN WG2 Meeting #113 Electronic Elbonia, 25th of January – 5th of February 2021

[4] [R2-2100382](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2100382.zip) *Idle mode operation in NTN* 3GPP TSG-RAN WG2 Meeting #113 Electronic Elbonia, 25th of January – 5th of February 2021

[5] [R2-2100163](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2100163.zip) *Discussion on idle/inactive mode procedures in NTN* 3GPP TSG-RAN WG2 Meeting #113 Electronic Elbonia, 25th of January – 5th of February 2021

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