3GPP TSG-RAN WG2 #118-e Tdoc R2-220xxxx

Electronic meeting, 2022-05-09 – 2022-05-20

Agenda Item: 7.2.3

Source: Ericsson

Title: Report of [AT118-e][051][IoT NTN] Idle Inactive mode

Document for: Discussion, Decision

# 1 Introduction

This is the report for the email discussion:

* [AT118-e][051][IoT NTN] Idle Inactive Mode (Ericsson)

Scope: Treat R2-2204711, R2-2205250, R2-2205331, R2-2205861, R2-2204651

Ph1 Determine agreeable parts, Ph2, agree/endorse TP(s) if applicable.

Intended outcome: Report, endorsed TPs/Draft CRs

Deadline: Schedule 1 (CB online W2 if needed)

In this e-mail discussion we will discuss idle mode issues.

# 2 Discussion

## 2.1 t-Service corrections

Contribution R2-2204711 [1] and R2-2205250 [2] propose to introduce corrections to the text related to how t-service functions.

In [1] it is proposed to change the wording similar to NR NTN and it is also proposed that inter-frequency measurements are included in text that is related to LTE-M.

------------------ TP1 ------------------

#### 5.2.4.2 Measurement rules for cell re-selection

<Removed irrelevant parts>

If *t-Service* is present in *SystemInformationBlockType3* of the serving cell, UE should start to perform intra-frequency, inter-frequency or inter-RAT measurements before the time *t-Service* regardless whether the serving cell fulfils Srxlev> SIntraSearchP and Squal > SIntraSearchQ, or Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, and the exact time to start measurement before *t-Service* is up to UE implementation. UE shall perform measurements of higher priority inter-frequencies or inter-RAT frequencies regardless of the remaining service time of the serving cell.

5.2.4.2a Measurement rules for cell re-selection for NB-IoT

<Removed irrelevant parts>

If *t-Service* is present in *SystemInformationBlockType3-NB* of the serving cell, UE should start to perform intra-frequency or inter-frequency measurements before the time *t-Service* regardless whether the serving cell fulfils Srxlev> SIntraSearchP and Squal > SIntraSearchQ, or Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, and the exact time to start measurement before *t-Service* is up to UE implementation.

------------------ TP1 ------------------

In [2], it is proposed to improve the text by using similar language and also removing the “should”, but simplified:

------------------ TP2 ------------------

#### 5.2.4.2 Measurement rules for cell re-selection

<Removed irrelevant parts>

Regardless of any procedure limiting measurements, if *t-Service* is present in *SystemInformationBlockType3* of the serving cell, UE may start to perform intra-frequency or inter-frequency measurements, before the time *t-Service*. UE shall perform measurements of higher priority inter-frequencies or inter-RAT frequencies regardless of the remaining service time of the serving cell.

#### 5.2.4.2a Measurement rules for cell re-selection for NB-IoT

<Removed irrelevant parts>

Regardless of any procedure limiting measurements, if *t-Service* is present in *SystemInformationBlockType3-NB* of the serving cell, UE may start to perform intra-frequency or inter-frequency measurements, before the time *t-Service*.

------------------ TP2 ------------------

It is clear that “should” is not according to 3GPP terminology and rapporteur intends to change this.

The first question is whether *t-Service* actions should include inter-RAT measurements as this has yet to be agreed. Inter-RAT is likely to imply a TN RAT and while a UE should likely prioritize a terrestrial network over non-terrestrial network, it could be potentially be an energy consumption waste to perform inter-RAT due to *t-Service*, thus it is not entirely clear whether inter-RAT measurements should be included in *t-Service* actions.

**Q1: Should *t-Service* actions include performing inter-RAT measurements as R2-2204711 [1]?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
| Huawei, HiSilicon | Y |  |
| OPPO | Y | The measurements before the stop time of the serving cell should also include inter-RAT frequency besides inter and intra-frequency. Otherwise, when the serving cell stops covering the current area, UE may lose the opportunity of camping in some cells belonging to other TN/NTN RAT.  Note that this would be in line with the wording captured in TS 38.304 for NR-NTN. |
| InterDigital | Y |  |
| Qualcomm | Y |  |
| Spreadtrum | Y | Agree with OPPO |
| Transsion Holdings | Y |  |
| Xiaomi | Y |  |
| Nordic | Y |  |
| CATT | Y |  |
| Lockheed Martin | Y |  |
| MediaTek | Y |  |
| ZTE | Y |  |
| Nokia | Y |  |
| Sequans | Y |  |
| Ericsson | Y | We find that it might be quite a large power waste to force UE to do inter-RAT measurement, which implies TN measurements, in NTN scenario where there are likely no TN around. But we are fine to go with majority. |

All companies agree that inter-RAT measurements should be included under t-Service. One company states that this might be power consuming for a UE NTN since inter-RAT implies TN measurements.

1. T-service includes inter-RAT measurements.

Rapporteur thinks that the text in [2] is more clean compared to the current text in 36.304-h00 [7], thus the question is whether to adopt the text in [1] or [2].

**Q2: Adopt the text that:**

1. **uses NR NTN text (R2-2204711) [1]**
2. **uses simplified text (R2-2205250) [2]**
3. **Other**

|  |  |  |
| --- | --- | --- |
| **Company** | **1/2/3** | **Comment or further text** |
| Huawei, HiSilcion | 1) with comments | Fine to align with NR wording  The text for NB-IoT is not correct as Squal is not used in the measurement rules  If *t-Service* is present in *SystemInformationBlockType3-NB* of the serving cell, UE should start to perform intra-frequency or inter-frequency measurements before the time *t-Service* regardless of whether the serving cell fulfils Srxlev> SIntraSearchP or Srxlev > SnonIntraSearchP , and the exact time to start measurement before *t-Service* is up to UE implementation.  About changing ‘should’ to ‘may’, we are not sure. we think it should be ‘shall’ for a UE supporting t-Service |
| OPPO | 1 | It would be simpler to capture this by the wording in TS 38.304 for NR-NTN. And agree with Huawei’s comments. |
| InterDigital | 1 with change suggested by Huawei | Agree with Huawei that Squal is not applicable for NB-IoT. |
| Qualcomm | 1 | In IDLE mode, it should be “should” or “may”. |
| Spreadtrum | 1 | Agree with Huawei’s comments. |
| Transsion Holdings | 1 |  |
| Xiaomi | 1 | Fine to use NR NTN text. |
| Nordic | 1 |  |
| CATT | 1 |  |
| Lockheed Martin | 1 |  |
| MediaTek | 1 |  |
| ZTE | 1 | Agree with HW’s comments for NB-IoT. We also think “shall” or “should” is suitable. |
| Nokia | 2 | May is preferred. |
| Sequans | 1 | Agree with HW comments (should/shall: no strong view). |
| Ericsson | 1 | Specifications does not use “should”. For reference, check usage of “should” in idle mode specifications compared to “shall” or “may”. |
|  |  |  |

Most companies agree that the text in NR NTN is preferred. Another comment is that Squal is not applicable for NB-IoT. Regarding the wording “UE should start to perform”, some companies stated different preferences regarding whether “may”, “should” or “shall” is to be used. It is noted in the contribution in [2] by the rapporteur of LTE Idle mode and that “should” is barely used in current specifications. The other alternative is “may” which is also problematic as it usually is related to *not* performing certain actions in idle mode or optionally allowed actions. As mentioned by one company, rapporteur finds that “shall” is the appropriate wording in line with the agreement as the UE is required to perform the measurements, but that the exact timing when it is done is up to UE implementation.

1. TP in R2-2204711 is agreed, where Squal is excluded from NB-IoT conditions and changing “should” to “shall” perform the measurements.

## 2.2 NTN-only UE

In R2-2205331 [3] and R2-2205861 [4] the editor’s note was addressed (this was also addressed in contribution R2-2205594 [5] (Interdigital contribution)):

Editor’s Note: FFS how an NTN-only UE is barred from accessing TN cell.

It is argued in [3] and [4] that NTN-only UEs do not need to be specified and the editor’s note can be removed and in [5] it is mentioned that it should be discussed. Thus rapporteur think it can be discussed here as the main impact identified has to do with barring-mechanism.

**Q3: Should there be any specification support for NTN-only UE in IoT NTN Rel-17?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
| Huawei, HiSilicon | No | Backward compatibility is a basic principle of 3GPP. This means a NTN UE shall support all mandatory features in the specification and this includes support of TN access. |
| OPPO | No | NTN UE must be capable to access TN since it has the mandatory capabilities for TN. This has just been agreed in NR NTN. |
| InterDigital | No |  |
| Qualcomm | No | TN capability is mandatory for NTN-only UE. It means that accessing TN is allowed for NTN-only UE. |
| Transsion Holdings | No |  |
| Xiaomi | No | We think there is no NTN-only UE since NTN capable UE must have mandatory TN capabilies. |
| Nordic | No |  |
| CATT | No |  |
| Lockheed Martin | No |  |
| MediaTek | No |  |
| ZTE | No |  |
| Nokia | No |  |
| Ericsson | No |  |

**Q4: If yes to Q3, should barring from accessing TN for NTN-only UE be introduced?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
|  |  |  |
|  |  |  |

All companies agree that there does not need to be any specification support for NTN-only UEs. This means that the editor’s note will be removed.

1. No specification support for NTN-only IoT UE in Rel-17.
2. Editor’s note on NTN-only UE is removed.

## 2.3 Barring mechanism

In R2-2205861 [4] the barring mechanism is discussed. It is explained that the current text in 36.304 reads:

- *cellBarred* (IE type: “barred” or “not barred”)   
This field indicates if the cell is barred for connectivity to EPC.  
This field is ignored by the UEs supporting *crs-IntfMitig* while *crs-IntfMitigEnabled* is included in SIB1.   
This field is ignored by the BL UEs or UEs in CE supporting *ce-CRS-IntfMitig* while *crs-IntfMigitNumPRBs* is included in SIB1-BR.  
This field is ignored by UEs supporting NTN while *cellBarred-NTN* is included in SIB1-BR or SIB1-NB.  
In case of multiple EPC PLMNs indicated in SIB1/SIB1-BR, this field is common for all EPC PLMNs

And that in 36.331 [8], the *cellBarred-NTN* is mandatory present in *cellAccessRelatedInfo-v1700* (*cellAccessRelatedInfoNTN-r17* in latest agreed RILs), but *cellAccessRelatedInfo-v1700* is optional. Thus there a slight discrepancy, where the presence of *cellBarred-NTN* may or may not be mandatory present for NTN, while the idle mode text implies that it does not always need to be present for NTN.

**Q5: Which change to resolve barring discrepancy in RRC/idle mode?**

1. None
2. Change the 36.304 text to “This field is ignored by UEs supporting NTN ~~while~~ *~~cellBarred-NTN~~* ~~is included in SIB1-BR or SIB1-NB~~.” And make *cellAccessRelatedInfo* mandatory present whenever NTN is deployed. This can for instance be achieved in a loss way by renaming *cellAccessRelatedInfo* to something that makes it clear it is for NTN only.
3. Keep 36.304 text and make *cellBarred-NTN* optional in RRC. Then the solution partly relies on the network configuring *cellBarred-NTN* correctly, by including *cellBarred-NTN* in scenarios when TN and NTN is deployed in the same bands and setting *cellBarred* to *barred*.
4. Other

|  |  |  |
| --- | --- | --- |
| **Company** | **½/3/4** | **Comment or further text** |
| Huawei, HiSilicon | 1 | We do not see any issue with the current text. Although we assume that *cellAccessRelatedInfo-NTN* (according to rapporteur CR) will normally be present in a NTN cell, we see no problem with a NW barring all UEs (TN and NTN) by using the legacy bit.  Option 2 is not enough because supporting NTN is not a reason to ignore the legacy bit in a TN cell |
| OPPO | 1 | We also do not see any issue with the current text.  For NTN cell, since legacy UE and R17 non-NTN capable UE cannot access the NTN cell due to lack of pre-compensation capability, etc. Therefore, we think NTN cell should always set cellBarred as “barred” to prevent the access of legacy UE and R17 non-NTN capable UE.  In this case, if cellBarred-NTN is not present in this NTN cell, UE supporting NTN could consider the cell to be barred according to cellBarred. |
| InterDigital | 1 | We see no problem with the current text. NW could bar all UEs using the legacy bit as others have stated. In addition, a TN cell won’t include this, so an NTN UE should ignore cellBarred only if cellBarred-NTN is present. |
| Qualcomm | 2 | We do not think current text is clear.  What is the reason *cellAccessRelatedInfo-v1700* is present in TN cell? Simply this should not happen to make things simple. So if this is not included, then the UE should consider the cell is TN cell. Then connectivity to TN is allowed but connectivity to NTN is not allowed. That’s how UE will behave.  Simply we need following correction in field description.  ***cellBarred-NTN***  barred means the cell is barred for connectivity to NTN, as defined in TS 36.304 [4]. If the field is included, the *cellBarred* is set to “barred”. If the field is not included, the UE considers the cell does not support NTN. |
| Spreadtrum | 1 | We also do not see any issue with the current text.  The NTN UE shall check cellBarred-NTN and ignore cellBarred to determine whether it is allowed or not in NTN cell. |
| Transsion Holdings | 1 | We also do not see any issue with the current text.  First of all, the legacy *cellBarred* should always set to barred when the cell is a NTN cell. If cellBarred-NTN is not present, then the legacy cellBarred also works for the NTN UE ,that doesn’t bring any problem. |
| Xiaomi | 1 | If cellAccessRelatedInfo-NTN is not present, the UE will follow the ceBarred in MIB, thus the NTN UE will be barred with large probability since ceBarred will normaly be set to barred.  For option 2, there is an issue when NTN capable UE access to the TN network. |
| Nordic | 1 |  |
| CATT | 1 |  |
| Lockheed Martin | 1 | We see no issue with the current text. |
| MediaTek | 1 |  |
| ZTE | 3 | We agree with above comments that the current text in TS 36.304 is correct while the proposed change in option 2) is not correct. TS So 36.304 text should be kept.  Moreover, we think the current description in TS 36.331 is incomplete. We high level think that Qualcomm’s above change suggestion for the field description of *cellBarred-NTN* is needed. In TS 36.304, we only mention NTN UE should ignore legacy barring bit when *cellBarred-NTN* is present. NTN UE doesn’t care what the value of legacy barring bit is.  So, we need to further reflect in somewhere the common understanding that legacy barring bit should be set “barred” in NTN cell. This is irrelevant cell’s congestion status, it’s just deliberately set. |
| Nokia | 2 | Agree with Qualcomm |
| Sequans | 1 | Agree with Huawei. |
| Ericsson | 2 | We realize that the 36.304 text needs to be kept as otherwise UE supporting NTN will ignore barred if connecting to TN cell.  We agree with some other commentors (Qualcomm) to try to make this very clear and simple. cellBarred is always set to ‘barred’ in NTN and cellBarred-NTN is always present in NTN to tell NTN UE whether it is barred. |
|  |  |  |

Rapporteur notes that a lot of companies stated that nothing needs to be changed, while still suggesting that for instance *cellBarred* is to always be set to barred, which rapporteur thinks would require some clarifications. Some input that was given:

* The current text is OK with the understanding:
  + “This field is ignored by UEs supporting NTN while *cellBarred-NTN* is included in SIB1-BR or SIB1-NB.” meaning that a UE 1) that supports NTN **and** at the same time 2) connects to an NTN cell – should ignore cellBarred.
  + NTN eNB always sets cellBarred to ‘*barred*’.
* The text in 36.331 should be changed to reflect
  + cellBarred is always set to ‘barred’ in NTN
  + cellBarred-NTN is always present.

Given that most agree that the text in 36.304 is correct, but some state that clarifications could be made more clear, thus there seems to be two options on the table:

* 1. No changes nor any clarifications with the following understanding:
  + *cellBarred* bars TN UE in case of TN and NTN in the same band and *cellBarred* bars NTN UE in case of NTN-only band if *cellBarred-NTN* is not present.
  + *cellBarred-NTN* can be present and not present in an NTN cell. In case of NTN-only band it does not need to be present, but when TN and NTN is in the same band it needs to be present to not bar NTN UEs.
* 2. Clarifications in 36.331:
  + *cellBarred* is always set to ‘barred’ in an NTN cell and
  + *cellBarred-NTN* is always present in an NTN cell to determine whether an IoT NTN UE is barred or not.

Rapporteur thinks that option 2 is the most clear option for a spec reader. As suggested this would correspond to the following field description:

***cellBarred-NTN***

barred means the cell is barred for connectivity to NTN, as defined in TS 36.304 [4]. If the field is included, the *cellBarred* is set to “barred”. If the field is not included, the UE considers the cell does not support NTN.

1. Add clarifications in RRC to ensure *cellBarred* is always set to ‘barred’ in an NTN cell and *cellBarred-NTN* is always present in an NTN cell to determine whether IoT NTN UE is barred or not.

## 2.4 Other open idle mode issues

**Companies can bring up further idle mode issues or corrections below:**

|  |  |
| --- | --- |
| **Company** | **Issue** |
| Ericsson | We still have the editor’s note on discontinuous coverage:  Editor's Note: FFS which parameters may be used for determining out of coverage and how network can configure that a UE may determine that it is out of coverage, i.e. through configuring SIB32 or not.  Question is whether to remove or not in R2-2205250 it was suggest to remove it due to how to determine that it is out of coverage is already mentioned in the above-mentioned text.  => (Rapporteur) Remove the part “which parameters may be used for determining out of coverage” and bring up the remaining FFS in e-mail discussion [AT118-e][057][IOT NTN] Discontinuous coverage (Gatehouse). |
|  |  |

# 3 Conclusion

Based on the discussion in the previous sections we propose the following:

[Proposal 1 T-service includes inter-RAT measurements.](#_Toc103526086)

[Proposal 2 TP in R2-2204711 is agreed, where Squal is excluded from NB-IoT conditions and changing “should” to “shall” perform the measurements.](#_Toc103526087)

[Proposal 3 No specification support for NTN-only IoT UE in Rel-17.](#_Toc103526088)

[Proposal 4 Editor’s note on NTN-only UE is removed.](#_Toc103526089)

[Proposal 5 Add clarifications in RRC to ensure *cellBarred* is always set to ‘barred’ in an NTN cell and *cellBarred-NTN* is always present in an NTN cell to determine whether IoT NTN UE is barred or not.](#_Toc103526090)

# 4 References

1. R2-2204711, Correction on Measurement rules for cell re-selection in IoT-NTN, OPPO, RAN2#118-e, May 2022
2. R2-2205250, 36.304 R17 editorial corrections, Nokia, Nokia Shanghai Bell, RAN2#118-e, May 2022
3. R2-2205331, Addressing 36.304 Editor’s note, Huawei, Hisilicon, RAN2#118-e, May 2022.
4. R2-2205861, IoT NTN idle mode issues, Ericsson, RAN2#118-e, May 2022.
5. R2-2204651, Clarification on TN NTN barring, Qualcomm Incorporated, RAN2#118-e, May 2022.
6. R2-2205594, IoT-NTN-only UE, Interdigital Inc., RAN2#118-e, May 2022.
7. 3GPP TS 36.304, User Equipment (UE) procedures in idle mode, V17.0.0, Release 17, March 2022.
8. 3GPP TS 36.331, Radio Resource Control (RRC), V17.0.0, Release 17, March 2022.