**3GPP T****SG-RAN WG2 Meeting #117-e R2-2203535**

**E-Meeting, Feb 21th – Mar 3rd, 2022**

**Agenda item:**  **8.10.4.1**

**Source: Intel Corporation**

**Title: Report of email discussion [AT117-e][104][NTN] UE caps open issues (Intel)**

**Document for: Discussion**

# Introduction

This is the report of the following email discussion:

* [AT117-e][104][NTN] UE caps open issues (Intel)

Initial scope: Discuss UE caps open issues based on the report in [R2-2202454](file:///C:\Data\3GPP\Extracts\R2-2202454%20Report%20of%20email%20discussion%20%5bPre117-e%5d%5b104%5d%5bNTN%5d%20UE%20caps%20open%20issues%20(Intel).docx) and other company contributions in AI 8.10.4

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 2022-02-21 1700 UTC

Initial deadline (for rapporteur's summary in R2-2203535): Monday 2022-02-21 2000 UTC

Proposals marked "for agreement" in R2-2203535 not challenged until Tuesday 2022-02-22 1000 UTC will be declared as agreed via email by the session chair (for the rest the discussion will continue during the GTW session on Tuesday).

# Discussion

According to the pre-meeting discussion on UE capabilities [1], the following proposals are made for easy agreements:

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| ** List of proposals for agreement:**  **Proposal 1: The SMTC enhancements (event-triggered assistance information reporting, 2 SMTC in parallel) are essential for NGSO capable UEs.**  **Proposal 4: Incorporate event-triggered TA reporting feature into TA reporting UE capability defined in RAN1 feature list.**  **Proposal 5: Specify single UE capability to represent the support of both UL HARQ state B and the new LCP restriction.**  **Proposal 6: Since it should not be assumed that every NTN capable UE has been tested to support both GSO and NGSO, define IoT bits for the support of {GSO, NGSO, both}.**  **Proposal 9: Add a note in 38.306 that for NTN NW restricts throughput based on the actual RTT to avoid buffer overflow.** |

This short at-meeting offline is supposed to make some progress even before the online discussion, as mentioned by session chair “Note that especially for the NR NTN offlines the deadlines are quite short, but the main intention for this initial round is basically to attempt email agreements for some of the proposals that were prepared as an outcome of the corresponding Pre117 discussions (needless to say, I encourage companies to be reasonable and accept as many as possible already in this initial round).”.

**Question 1: Whether the following proposals can be agreeable?**

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| ** List of proposals for agreement:**  **Proposal 1: The SMTC enhancements (event-triggered assistance information reporting, 2 SMTC in parallel) are essential for NGSO capable UEs.**  **Proposal 4: Incorporate event-triggered TA reporting feature into TA reporting UE capability defined in RAN1 feature list.**  **Proposal 5: Specify single UE capability to represent the support of both UL HARQ state B and the new LCP restriction.**  **Proposal 6: Since it should not be assumed that every NTN capable UE has been tested to support both GSO and NGSO, define** **IoT bits for the support of {GSO, NGSO, both}.**  **Proposal 9: Add a note in 38.306 that for NTN NW restricts throughput based on the actual RTT to avoid buffer overflow.** |

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| --- | --- | --- |
| **Company** | **Y or N** | **Additional comments** |
| Huawei, HiSilion | Y | Regarding P4, we still think “TA reporting during initial access” should be optional without capability because the NW does not know UE capability yet during initial access, so the RAN1 capability should refer only to “TA reporting in Connected mode” (this is not the intention of RAN1, so they should be informed). But we can accept P4 if the majority of companies prefer it. |
| ZTE | Y |  |
| Nokia | Partly Y | On P6: will that in practice mean that there is no mandatory set of NTN capabilities which all UEs support (no matter if they operate in NGSO or GSO), but each time there will be a need to indicate with IoT bit?  On P9: we think such note is not essential. |
| Lenovo, Motorola Mobility | Y |  |
| MediaTek | Y |  |
| OPPO | Y |  |
| Xiaomi | Y |  |
| Samsung | Y |  |
| Qualcomm | Comments for P6  N for P9  Y for others. | On P6, it is not clear if this is indication is only for the essential features or for whole container.  P9: we agree with Nokia. What network behaviour is does not need to be captured in the specification. |
| vivo | Y |  |
| Ericsson | Partly  P6: N  P9: N | On P6: we think this may greatly increase the number of UE capabilities and that it is better to clarify for each feature the technical limits, especially all legacy features shall not need GSO/NGSO/both indications.  On P9: not needed. |
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**Summary:**

Companies are fine with the following proposals:

**Proposal 1: The SMTC enhancements (event-triggered assistance information reporting, 2 SMTC in parallel) are essential for NGSO capable UEs.**

**Proposal 4: Incorporate event-triggered TA reporting feature into TA reporting UE capability defined in RAN1 feature list.**

**Proposal 5: Specify single UE capability to represent the support of both UL HARQ state B and the new LCP restriction.**

For P6, the concerns are whether it “means that there is no mandatory set of NTN capabilities which all UEs support”, and “if this indication is only for the essential features or for whole container”.

Regarding the first concern, as RAN2 has agreed that “define one single NR NTN UE capability to encompass essential features to support NTN”, there is still “mandatory set of NTN capabilities”. But with this newly introduced IoT bits, they are actually like “mandatory with capability signalling”, which means although UE is mandatory to support this “mandatory set of NTN capabilities”, there are still IoT bits to show whether the UE has been tested in the corresponding scenario.

As for the second concern, since these IoT bits are specific for application scenarios, they are supposed to cover all essential and optional UE capabilities. And rapporteur suggests to further revise P6 as below

**Proposal 6: Since it should not be assumed that every NTN capable UE has been tested to support both GSO and NGSO, define IoT bits for the support of {GSO, NGSO, both} and this indication means all NTN essential features and optional features UE indicates have been tested in the corresponding scenario(s).**

For P9, it seems the concern is whether a Note is needed, rapporteur suggests to add an FFS for this part. And P9 can be revised as follows:

**Proposal 9: For NTN, network should restrict throughput based on the actual RTT to avoid UE buffer overflow. FFS if a note in 38.306 is needed.**

According to [2], the following open issues are identified to be postponed due to lack of stage-3 detail or input from other WGs:

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| **List of open issues on NR NTN UE capabilities**  **Set 2 for postponed open issues:**  **Postponed discussion (need to wait for other WG’s input or more stage-3 discussion):**   1. Postpone the discussion on granularity of SMTC UE capabilities (e.g., 4 SMTC in parallel), since RAN1/4 may define them as per band 2. Postpone the UE capability discussion on measurement gaps for connected mode; 3. Postpone the UE capability discussion on location reporting. |

The following proposals from companies’ papers are related to the open issues above:

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| proposals from [3]:  **Proposal 1 Multiple measurement gap patterns is an essential capability for NGSO.**  **Proposal 2 No separate capability is introduced for measurement gaps for connected mode.**  **Proposal 3 Location reporting should be a mandatory capability.**  proposal from [4]:  **Proposal 1: it is proposed to specify the SMTC enhancement with 4 SMTC configurations in parallel as optional sub-features, and can be** **revisited based on RAN4/RAN1’s further input.**  **Proposal 2: it is proposed that this capability is per band, not per UE.**  **Proposal 3: it is proposed to specify the extended GAP length and/or the number of multiple GAPs as optional sub-features, and the detailed number and length can be specified based on RAN4/RAN1’s input.**  proposal from [6]:  **Proposal 4: An optional UE capability should be added to indicate the support of multiple NTN measurement gaps for NGSO.** |

Regarding gap enhancements, it’s still not clear about the stage-3 detail. And for location reporting, RAN2 is still waiting for other WGs’ reply. With respect to 4 SMTCs in parallel, we can try if some consensus can be made for now.

**Question 2: Regarding 4 SMTCs in parallel, which option can be adopted:**

**Option 1: Postpone the discussion until RAN1/4 input is received;**

**Option 2: Define per-band optional UE capability for 4 SMTCs in parallel, and revisit it based on RAN4/RAN1’s further input.**

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| **Company** | **option 1 or 2** | **Additional comments** |
| Huawei, HiSilion | Option 1 |  |
| ZTE | Option 1 |  |
| Nokia | Option 1 | It is OK to wait for one more meeting, UE capabilities can be finalized after we freeze the functional specification. |
| Lenovo, Motorola Mobility | Option 1 |  |
| MediaTek | Option 1 |  |
| OPPO | Option 1 |  |
| Xiaomi | Option 1 |  |
| Samsung | Option 1 |  |
| Qualcomm | Option 2 | If we go with option 1, then we suggest sending LS to RAN4 otherwise RAN4 may not discuss or provide any feedback on this. |
| vivo | Option 1 | UE capability discussion is not in urgency anyway. |
| Ericsson | Option 1 |  |
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**Summary:**

The majority view is to wait for RAN1/4 further input. And one company also raises a point that a LS is needed otherwise “RAN4 may not discuss or provide any feedback on this”. Since current plan is RAN1 and RAN4 provide the updated feature list by the end of first meeting week. Rapporteur suggests to make the following proposal:

**Proposal 10:** **Postpone the discussion on NTN SMTC UE capabilities, and if the updated RAN1/4 feature lists during this meeting don’t include NTN SMTC related UE capabilities, RAN2 sends an LS to RAN1/4 for triggering this discussion.**

One proposal in [6] raises another UE capability for HARQ process number as below:

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| Apart from the discussion on measurement gaps, we think it is also useful to add a UE capability for the supported number of HARQ processes. In the current spec, the UE supports 16 UL/DL HARQ processes. For NTN, RAN1 has introduced a UE feature of supporting 32 HARQ processes, with an optional capability [2]. The main motivation is to avoid HARQ stalling due to the large RTD. Moreover, in NTN, some HARQ processes can be retransmitted (state A) and others can be configured as no-retransmission (state B).  From our perspective, it is beneficial for UEs to report its maximum number of HARQ processes to be retransmitted. For instance, a UE can report it supports a maximum of 16 HARQ processes of state A, then the NW can configure 16 HARQ processes of state A and 16 HARQ processes of state B, and the 16 state B processes can share a common buffer. If not reported, the NW could configure all 32 HARQ processes as state A, which may exceed the UE competence.  **Proposal 5: Introduce an optional capability for the maximum number of HARQ processes to be retransmitted.** |

**Question 3: Whether** **to have separate UE capability to indicate maximum number of state A HARQ processes?**

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| **Company** | **Y or N** | **Additional comments** |
| Huawei, HiSilicon | Y | Proponent. |
| Nokia | N | We see no critical need for this separate UE capability. In our understanding this 32 should not be split statically into A and B. So it is up to NW how to use it and UE does not need to signal any additional capability. |
| MediaTek | N |  |
| OPPO | N | Optionally indicating the support of 32 HARQ processes is sufficient. |
| Xiaomi | N |  |
| Samsung | N | We think it’s fine to rely on NW configuration. |
| Qualcomm | N |  |
| vivo | N | We think the RAN1-introduced maximum supported HARQ process is already enough. |
| Ericsson | N |  |
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**Summary:**

As the majority view is not to have separate UE capability to indicate maximum number of state A HARQ processes, no proposal is made in this aspect.

In [1] the following proposal is made for SMTC enhancements applied in GSO.

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| **Proposal 2: RAN2 to further discuss whether the SMTC enhancements (event-triggered assistance information reporting, 2 SMTC in parallel) are also essential for GSO capable UEs, considering except GEO satellites in general other GSO satellites are also moving.** |

According to the observations in [5] as below, UE can also benefit from SMTC enhancements in GSO case.

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| **Observation 1: For a short time, e.g. several minutes, GSO satellites could be considered as “stationary”. But for a long time, e.g. several hours, the movement of GSO cannot be ignored.**  **Observation 2: In GSO scenario, one UE may be served by a bunch of satellites one by one, or one UE may be in the overlap area of several GSO satellites, which requires multiple SMTCs to track different neighbour cells.** |

**Question 4: Whether the SMTC enhancements (event-triggered assistance information reporting, 2 SMTC in parallel) are also essential for GSO capable UEs?**

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| **Company** | **Y or N** | **Additional comments** |
| Huawei, HiSilicon | N | Agree that the SMTC enhancements can be used for GSO as well (mainly for GSO-NGSO mobility), but we think it can be an optional capability since it is unclear for the moment whether GSO-NGSO mobility is common in real deployment. |
| ZTE | Y |  |
| Nokia | Y | We think event-triggered assistance info and 2 SMTCs in parallel should be mandatory for all NTN UEs (not only NGSO). |
| Lenovo, Motorola Mobility | Y |  |
| MediaTek | N |  |
| OPPO | N | Agree with Huawei |
| Xiaomi | N |  |
| Samsung | N |  |
| Qualcomm | Y/N | As we mentioned before, it may be better first to clarify whether GSO to NGSO mobility needs to be supported. It can be conditional based on GSO to NGSO mobility support. |
| vivo | Y | We can follow the majority’s view. |
| Ericsson | N | Even in the case of multiple GSO satellites overlapping, the movement can be ignored only for long periods of time. In this case, a validity timer would suffice (R2-2202564). |
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**Summary:**

There is still no consensus on whether the SMTC enhancements (event-triggered assistance information reporting, 2 SMTC in parallel) are also essential for GSO. And one company thinks RAN2 also needs to discuss whether mobility between GSO and NGSO is supported. Taking the IoT bits for scenarios into account, rapporteur suggest to add a new proposal for further discussion.

**Proposal 11: RAN2 to discuss whether** **IoT bit for the support of {both GSO and NGSO} means UE also supports mobility between GSO and NGSO.**

In [1] the following controversial open issues are suggested to go for online discussion:

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| **(10/14) Proposal 3: CHO enhancements (time based and Event A4 based CHO) are optional to support for NTN capable UEs.**  **Proposal 7: RAN2 to discuss whether we plan to check case by case if a TN optional UE capability needs a separate IoT bit for NTN.**  **Proposal 8: If there is no plan to check case by case, RAN2 to further discuss how to support separate UE capability reporting for TN and NTN:**  **Option 1**: IoT bits for NTN are reported together with TN features, e.g., have an embedded ASN.1 structure as below:  UE-NR-Capability ::= SEQUENCE {  <Unnecessary parts omitted>  iotBitsNTN UE-NR-Capability OPTIONAL,  <Unnecessary parts omitted>  }  **Option 2**: Existing capability signalling is used but only valid in the network type it is reported to (e.g. when UE reports to NTN network the capability refers to NTN and not TN).  **Option 3**: Add nr-ntn as a new RAT-type for UE capability reporting, in this case NTN source gNB can get UE TN capabilities to support handover preparation from NTN to TN. |

Since we may not have enough time during this very short first round, rapporteur still suggests to go for online discussion or second round at-meeting offline.

# Conclusion

Based on this offline discussion on UE capabilities, the following proposals are made:

** List of proposals for agreement:**

**Proposal 1: The SMTC enhancements (event-triggered assistance information reporting, 2 SMTC in parallel) are essential for NGSO capable UEs.**

**Proposal 4: Incorporate event-triggered TA reporting feature into TA reporting UE capability defined in RAN1 feature list.**

**Proposal 5: Specify single UE capability to represent the support of both UL HARQ state B and the new LCP restriction.**

**Proposal 9: For NTN, network should restrict throughput based on the actual RTT to avoid UE buffer overflow. FFS if a note in 38.306 is needed.**

**Proposal 10:** **Postpone the discussion on NTN SMTC UE capabilities, and if the updated RAN1/4 feature lists during this meeting don’t include NTN SMTC related UE capabilities, RAN2 sends an LS to RAN1/4 for triggering this discussion.**

** List of proposals that require online discussions:**

**Proposal 2: RAN2 to further discuss whether the SMTC enhancements (event-triggered assistance information reporting, 2 SMTC in parallel) are also essential for GSO capable UEs, considering except GEO satellites in general other GSO satellites are also moving.**

**Proposal 3: CHO enhancements (time based and Event A4 based CHO) are optional to support for NTN capable UEs.**

**Proposal 6: Since it should not be assumed that every NTN capable UE has been tested to support both GSO and NGSO, define IoT bits for the support of {GSO, NGSO, both} and this indication means all NTN essential features and optional features UE indicates have been tested in the corresponding scenario(s).**

**Proposal 7: RAN2 to discuss whether we plan to check case by case if a TN optional UE capability needs a separate IoT bit for NTN.**

**Proposal 8: If there is no plan to check case by case, RAN2 to further discuss how to support separate UE capability reporting for TN and NTN:**

**Option 1**: IoT bits for NTN are reported together with TN features, e.g., have an embedded ASN.1 structure as below:

UE-NR-Capability ::= SEQUENCE {

<Unnecessary parts omitted>

iotBitsNTN UE-NR-Capability OPTIONAL,

<Unnecessary parts omitted>

}

**Option 2**: Existing capability signalling is used but only valid in the network type it is reported to (e.g. when UE reports to NTN network the capability refers to NTN and not TN).

**Option 3**: Add nr-ntn as a new RAT-type for UE capability reporting, in this case NTN source gNB can get UE TN capabilities to support handover preparation from NTN to TN.

**Proposal 11: RAN2 to discuss whether** **IoT bit for the support of {both GSO and NGSO} means UE also supports mobility between GSO and NGSO.**

# References

1. [R2-2202454](file:///C:\Data\3GPP\Extracts\R2-2202454%20Report%20of%20email%20discussion%20%5bPre117-e%5d%5b104%5d%5bNTN%5d%20UE%20caps%20open%20issues%20(Intel).docx) Report of email discussion [Pre117-e][104][NTN] UE caps open issues (Intel)

Intel Corporation

1. [R2-2202454](file:///C:\Data\3GPP\Extracts\R2-2202454%20Report%20of%20email%20discussion%20%5bPre117-e%5d%5b104%5d%5bNTN%5d%20UE%20caps%20open%20issues%20(Intel).docx) List of open issues on NR NTN UE capabilities Intel Corporation
2. [R2-2203485](file:///C:\Data\3GPP\Extracts\R2-2203485%20-%20NR%20NTN%20UE%20capabilities.docx) NR NTN UE capabilities Ericsson
3. [R2-2202725](file:///C:\Data\3GPP\Extracts\R2-2202725%20Remaining%20Issues%20of%20Set2%20on%20NR%20NTN%20UE%20Capabilities.docx) Remaining Issues of Set2 on NR NTN UE Capabilities CMCC
4. [R2-2202459](file:///C:\Data\3GPP\Extracts\R2-2202459%20Discussion%20on%20the%20difference%20between%20GSO%20and%20GEO.docx) Discussion on the difference between GSO and GEO Intel Corporation
5. [R2-2202887](file:///C:\Data\3GPP\Extracts\R2-2202887%20Discussion%20on%20capabilities%20for%20gaps%20and%20HARQ.doc) Discussion on capabilities for gaps and HARQ Huawei, HiSilicon