**3GPP TSG-RAN WG4 Meeting #111 R4-2409959**

**Fukuoka, Japan, May 20 – May 24, 2024**

**Title:** Way Forward for [111][315] NR\_NTN\_Ph3

**Agenda Item:** 10.15.4

**Source: THALES**

**Document for:** Approval

# Introduction

This WF at RAN4#111 meeting is for [111][315] NR\_NTN\_Ph3 (R4-2410110, Topic summary for [111][315] NR\_NTN\_Ph3).

# Way forward

**Issue 1-1-1: RedCap release independence**

**Discussion with respect to UE discussion moved to main session.**

**Issue 1-2-1: Figures for regenerative payload**

* Agreements: No update required for TS 38.108 section 4 “requirements reference points diagrams”. Keep SAN type 1-H and for SAN type 1-O figures as agnostic to the regenerative/non-regenerative functionality of the SAN.
* **Moderator note (for clarification of the discussion):** The view of other group different from RAN4 (e.g. RAN3) may be different. (At least some) ground gNB functions should be represented on the right-hand side of the GW, between Feederlink and NTN payload RF, as part of NTN payload.

**Issue 1-2-2: SAN definition update**

* Agreement: **“Satellite Access Node**: node providing NR user plane and control plane protocol terminations towards NTN Satellite capable UE, and connected via the NG interface to the 5GC. It encompass a transparent NTN payload on board an NTN platform, a gateway and gNB functions, or a regenerative NTN payload on board an NTN platform and a gateway.”

**Issue 1-2-3: “Satellite” definition update**

* Agreement: “**satellite:** A space-borne vehicle embarking a ~~bent pipe payload~~ transparent payload or a regenerative payload telecommunication transmitter, placed into Low-Earth Orbit (LEO) or Geostationary Earth Orbit (GEO).

**Issue 1-2-4: Add Clarification Notes in TS 38.108**

* Agreement: Add clarification note in the Scope of TS 38.108 Rel-19, clarifying that this version of specification covers both non-regenerative, and regenerative payload options, i.e.:
  + “NOTE: This version of specification supports SAN with transparent payload, as well as SAN with regenerative payload.”

**Issue 1-2-5: Alignment of TS 38.101-5 & TS 38.181 with TS 38.108**

* Agreement: TS 38.101-5 and TS 38.181 (scope, definitions, SAN figures) to be aligned with modifications related to introduction of regenerative payload in TS 38.108.
  + NOTE: Some of the modifications proposed in this Rel-19 discussions are actually applicable to Rel-17 specifications (TS 38.108, TS 38.181, TS 38.101-5). Therefore, related CRs were submitted under maintenance Agendas 4.1 and 4.2 in [6-11].

**Issue 1-3-1: Cell DTX**

**Issue 1-3-2: RF requirements enhancements for spatial domain techniques**

* Agreement: companies encourage to further investigate SAN beam hopping in DL coverage enhancements for both FR1 and FR2
  + clarify “transient time” meaning, if for beam switching delay or PA switch ON/OFF or frequency carrier.
  + Synchronisation aspects:
    - between ground gNB and satellite payload for transparent architecture;
    - between two or more transparent satellites serving the same Earth-fixed cell. FFS for Earth-moving cell.
  + NOTE: FFS if above issue could be treated as requirement or implementation specific.
* Working hypothesis: PA always on, phase shift (pre-)reconfiguration to perform beam-hopping.
  + **NOTE1: [RAN1 agreement]** For NR NTN Rel-19 DL coverage evaluation, a value of beam steering latency equal to zero at least if SAN phase array antenna is assumed. Values different from zero beam steering latency can be optionally reported by companies if any potential issue identified.
  + **NOTE2:** Other implementation with analog beam steering technologies are not precluded. Companies to further discuss if analog/digital antenna assumptions and for which FR1/FR2 implementations.

# Annex with discussions at RAN4#111 for [111][315] NR\_NTN\_Ph3

**Issue 1-1-1: RedCap release independence**

Huawei: This is already being discussed in main session since this is UE topic

ZTE: Agree with Huawei. Should be discussed in main.

**Issue 1-2-1: Figures for regenerative payload**

ZTE: Fine to keep current figures

**Issue 1-2-2: SAN definition update**

CATT: We agree to the approach of single definition, but the wording needs correction

Huawei: In Rel-17, we already have wording for both. We prefer single definition.

Samsung: Prefer proposal 1 and we can reword

ZTE: We want a clear definition. We don’t have a strong opinion whether it is a single definition or split into two

**Issue 1-2-3: “Satellite” definition update**

Viasat: “bent pipe” should be reworded to “transparent”

**Issue 1-3-1: Cell DTX**

Ericsson: 10us and 3us is for digital switching?

ZTE: This is for on/off transition time. Digital beam switching is much faster

Ericsson: The focus should be beam switching. The PA will always be on

ZTE: There seems to be a difference of understanding on Cell DTx. Our understanding of Cell DTx is similar to NES, to turn on and off the cell.

Ericsson: Rel-19 power savings objective is different from NES. The Rel-19 power savings objective addresses the issue of finite power not being able to cover all the beams. In this case, the PA is always on but it’s a matter of switching beams.

ZTE: Is Cell DTx of the NTN WID beam hopping? Cell DTx originally comes from NES. Can the rapporteur clarify it?

Thales: SAN performs beam hopping. The satellite is always transmitting, just not able to illuminate all beams at the same time. Other implementations might be different.

Huawei: This should be clarified at RAN plenary

Ericsson: This is different from NES

TTP: Is beam hopping and beam switching the same thing? Does this apply only to FR2? Does it apply only to earth moving cell?

Thales: Same. Both FR1 and FR2. First priority is earth fixed, but earth moving is not precluded.

Thales: In our view we can consider two options. The first option is to reduce the power to all beams. The second option is to switch beams from one region to another so fewer active beams, but more power per beam. One option is not to introduce any requirement for switching period since it is expected to be negligibly short.

Ericsson: RAN1 is considering the case where only a subset of beams is active for the case of limited power availability.

Inmarsat: Beam hopping is also motivated by finite number of RF chains or ports, not just power limitation. Why do we need a delay requirement at all?

ZTE: We need to ensure the time delay of the phase shifter, otherwise, it can be slow. We have not had a requirement if it is not testable. If all companies confirm a very short switching delay is achievable and there is no impact to the UE if it is within the CP, then a requirement may not be needed.

Ericsson: Whether we need a requirement depends on the expected value. Whether such switching delay will cause a system problem. There is also a synchronization issue between satellite and gNB.

Thales: We have a different understanding of what is the transient period. We are expecting ~100ns.

**Issue 1-3-2: RF requirements enhancements for spatial domain techniques**

Huawei: We should not send the LS to RAN1. If an implementation is not able to meet a switching delay, then it should not support the coverage enhancement feature

Ericsson: We need to consider not only switching delay but also the error in synchronization time. We need to investigate further.

Samsung: RAN1 has not developed a solution for DL coverage enhancements. They have only agreed initial simulation parameters. We should wait for further RAN1 progress before discussing in RAN4.

ZTE: The delay from baseband command to the phase shifter is on the order of ms. The actual actuation delay at the phase shifter is ~50 – 100ns. These are different issues. Whether the baseband can properly time the command to the phase shifter in advance is an implementation issue. We only need to worry about the phase shifter delay itself.

Nokia: We should wait before considering sending an LS to RAN1.

**Issue 1-3-4: Network synchronisation**

Inmarsat: We support proposal 1. This should be considered for implementation, but not something that needs to be specified. This should be implementation only. This has nothing to do with the RAN1 work.

Samsung: If there is no specification impact, then we don’t need to discuss this objective in RAN4.

ZTE: For TN, we did have network synchronization requirements captured in RRM; i.e., 3us for BS synch error

Ericsson: We need to consider it

Thales: For the feeder link there is nothing defined in 3GPP. The impact of feeder link on system performance is completely unknown to 3GPP.

Inmarsat: This is present also in Rel-17, it’s not new for Rel-19. Even for TN if the BB and radio are in separate units, there is also some kind of synchronization needed. This is the same thing. We don’t need or want a new requirement.

# Issues from Topic Summary not discussed at RAN4#111 for [111][315] NR\_NTN\_Ph3

**Issue 1-3-3: Network energy saving**

* Proposals:
  + **Proposal 1:**
    - No need to consider the spatial and power domain in Rel-18 NES impact on NTN RF for now. (P4/[R4-2409107](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409107.zip))
    - Network energy saving feature in Rel-18 can be starting point for RF impact analysis for Rel-19 NTN DL coverage enhancement objective. (P1/[R4-2404869](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404869.zip))
  + **Proposal 2:** Postpone the discussion on objective 1 (DL Coverage Enhancements) until sufficient progress made by RAN1. (P2/[R4-2408071](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408071.zip))
* Recommended WF
  + TBD;
  + **Proposed WF from moderator:** Agree with Proposal 1 if no controversial comments. Add Proposal 2 as a Note.

**Issue 1-3-4: Network synchronisation**

* Proposals:
  + **Proposal 1:** The network synchronization aspect should be considered for transparent payload together with beam switching delay. (P3/[R4-2409107](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409107.zip))
  + **Proposal 2:** Postpone the discussion on objective 1 (DL Coverage Enhancements) until sufficient progress made by RAN1. (P2/[R4-2408071](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408071.zip))
* Recommended WF
  + Agree with Proposals 1/2 if no controversial discussion, add Proposal 2 as a note.

**Issue 1-4-1: OCC - UL capacity/throughput Enhancements for FR1-NTN**

* Proposals:
  + **Proposal 1:** No SAN RF requirement impact foreseen for objective 2 “Uplink Capacity/Throughput Enhancement for FR1-NTN “. (P3/[R4-2408071](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408071.zip))
  + **Proposal 2: RAN4 waits for further progress on RAN1 work items** to identify the RF requirement enhancements needed for NR NTN phase 3 for objective 2 (UL capacity/throughput Enhancements). (P2/[R4-2405082](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405082.zip))
* Recommended WF
  + TBD

**Issue 1-5-1:** **RAN4 SAN RF impact – Broadcast service**

* Proposals:
  + No SAN RF requirement impact for objective 3 “Broadcast service via NR NTN”. (P4-1/[R4-2408071](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408071.zip))
* Recommended WF
  + TBD, Agree if no controversial comments.