3GPP TSG-RAN WG2 Meeting #124 R2-231xxxx

Chicago, USA, Nov. 13th – 17th, 2023

**Title: DRAFT LS on RAN2 agreements for satellite switch with resync**

**Response to: -**

**Release: Release 18**

**Work Item: NR\_NTN\_enh-Core**

**Source: Apple (to be RAN2)**

**To: RAN4**

**Cc: RAN1**

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**Attachments:** **R2-2313877**

# 1 Overall description

For mobility enhancement in Rel-18 NR NTN, in quasi-earth fixed cell case, RAN2 agreed to support unchanged PCI satellite switch in the same SSB frequency and same gNB (no key change), without L3 mobility involvement, and call this feature “satellite switch with re-sync”. For the satellite switch with re-sync procedure, RAN2 endorsed the RACH-less satellite switch procedure as shown in Figure-1 in R2-2313877 as the baseline which will be further checked in the CR review.

RAN2 also agreed to support hard satellite switch (non-overlapping satellite coverage at switching time) and soft satellite switch (overlapping satellite coverage at switching time). The soft satellite switch procedure and the hard satellite switch procedure are the same except for the following two differences.

* Difference 1: The time for UE to initiate the satellite switch procedure is different.
  + For hard satellite switch, UE initiates the procedure after the source satellite stops serving the area it is currently covering service (i.e. T-service).
  + For soft satellite switch, UE can initiate the procedure before the source satellite stops serving the area it is currently covering service (i.e. T-service) and after the target satellite starts serving the same area (i.e. T-start), and the exact time when the UE starts synchronizing with target satellite (between T-start and T-service) is up to UE implementation. RAN2 assumes that it may be possible that a UE supporting soft satellite switch is capable of starting synchronizing to the DL of the SpCell served by the target satellite while still being connected to the source satellite (without any simultaneous communication with the source and the target satellites),  and would like to check with RAN4 whether it is feasible.
* Difference 2: The SSB information provided to UE for synchronizing with target satellite is different.
  + For soft satellite switch, the SSB information of target satellite is mandatory.
  + For hard satellite switch, the SSB information of target satellite can be same as source and can be optional.

In RAN2#124 meeting, RAN2 also made the following agreements on the design, and the parts highlighted in yellow may require the RAN4’s work.

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| Agreements:   1. introduce one new target satellite configuration, e.g. ntn-TargetSatConfig, (but we can keep the current terminology in the running CR) and provide the NTN-config of the target satellite in it for the specific signaling format about the target satellite information in SIB19. The presence of this information indicates that satellite switch without PCI change is supported 2. At least for soft switch, there needs to be an “SSB time offset” between the source and the target satellite. “SSB time offset” is specified as a new IE, with the same format as “offset” in SSB-MTC4 3. Target satellite SSB tracking is handled autonomously by the UE based on the provided SSB time offset 4. The “SSB time offset” between the source and the target satellite should be provided in SIB19 5. For soft satellite switch, as a baseline, it is sufficient to provide the “SSB time offset” of the target satellite in SIB19. (Can come back in the next meeting to check whether a different SSB index for the target satellite can optionally be provided) 6. Support implicit indication to inform UE it is hard switch or soft switch case 7. T-start is explicitly signalled (same format as T-service). If T-start is not signalled, T-start is assumed to be equal to T-service, i.e. hard switch. 8. For R18 we clarify that signalling a T-start higher than T-service is an unforeseen case and the UE will assume T-start = T-service 9. During satellite switching procedure, UE should reset the L3 filter for serving cell RRM measurement and RLM, and it’s up to UE implementation (i.e. no RAN2 spec impact). 10. If UE receive the HO command before UE initiates the satellite switching procedure (i.e. before the time point of satellite switching), UE will initiate the HO procedure immediately. 11. Both CHO and satellite switching procedure can be configured simultaneously. 12. When both CHO (for a different cell) and satellite switching procedure are configured, the UE initiates the procedure that triggers earlier; it's up to UE implementation if both procedures are triggered at the same time. 13. This feature will be called “satellite switch with re-sync” 14. RACH-less satellite switch procedure as shown in Figure-1 in R2-2313877 is endorsed as the baseline to be further checked in the CR review 15. Check in the RRC CR review whether the UE may need to acquire SIB19 immediately when UE acquires DL sync of target satellite 16. We don’t introduce specific changes (e.g. no new indication in SIB19) to a support RACH-based procedure but this does not exclude the possibility for the NW to trigger PDCCH order 17. A UE supporting TA reporting may trigger TAR and TAR-SR based on network configuration (as in legacy) 18. It is up to NW implementation to signal T-start, e.g. if it does not want to receive UL TX before T-service (if there is no T-start, UL TX cannot happen before T-service) |
| Agreements on related capabilities:  1. For UE capability(es that indicate the support of satellite switch with re-sync (i.e., unchanged PCI) with hard and soft switch, two UE capabilities are introduced with some dependencies: hardSatelliteSwitch-Resync-NTN-r18 can be supported by itself; but if UE supports softSatelliteSwitch-Resync-NTN-r18, UE is required to also indicate the support of hardSatelliteSwitch-Resync-NTN-r18.  2. A UE only supporting hardSatelliteSwitch-Resync-NTN-r18 will be able to perform hard satellite switch with re-sync (after T-service) in a NW supporting soft satellite switch with re-sync (and then broadcasting “T-start” and "SSB time offset"). To be reflected in the description of hardSatelliteSwitch-Resync-NTN-r18 |

# 2 Actions

**To RAN4**

**ACTION:** RAN2 respectfully asks RAN4 to take the above agreements into account for their further corresponding work, and also provides feedback on the feasibility of UE to perform the downlink synchronization with the target satellite and keep the communication with the source satellite of the same serving cell simultaneously in soft satellite switch.

# 3 Dates of next TSG-RAN WG4 meetings

3GPP TSG RAN WG2#125 26 February - 1 March 2024 Athens, Greece

3GPP TSG RAN WG2#125bis 15 April - 19 April 2024 China (TBC), CN