**3GPP TSG-RAN WG3 Meeting #124 *draft R3-243866***

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

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.300** | **CR** | **-** | **rev** | **-** | **Current version:** | **18.1.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **X** | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | Support for Regenerative Payload in NR NTN | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson, Thales, Deutsche Telekom, Nokia, ESA, CATT, ZTE, Sateliot, Huawei, Dish Networks, Echostar, Eutelsat Group, Xiaomi, Samsung | | | | | | | | | |
| ***Source to TSG:*** | R3 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_NTN\_Ph3-Core | | | | |  | ***Date:*** | | | 2024-05-23 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-19 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | In Rel-19, gNB on board the satellite is supported. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Specify the stage 2 description for regenerative payload with gNB on board. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | No stage 2 description for the regenerative payload with gNB on board. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.2, 16.14.1, 16.14.4.1, Annex B.4 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | | Other stage 2 changes may be needed but they are out of RAN3 scope. | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | R3-242044 submitted to RAN3 #123bis | | | | | | | | |

**START OF CHANGES**

## 3.2 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], in TS 36.300 [2] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1] and TS 36.300 [2].

**UNCHANGED PART OMITTED**

**NTN Gateway**: an earth station located at the surface of the earth, providing connectivity to the NTN payload using the feeder link. An NTN Gateway is a TNL node.

**NTN payload**: a network node, embarked on board a satellite or high altitude platform station, providing connectivity functions, between the service link and the feeder link. The NTN payload may be a TNL node (transparent payload) or a gNB (regenerative payload).

Editor’s Note: Pending RAN2 update, if any.

**Numerology**: corresponds to one subcarrier spacing in the frequency domain. By scaling a reference subcarrier spacing by an integer *N*, different numerologies can be defined.

**UNCHANGED PART OMITTED**

**NEXT CHANGE**

## 16.14 Non-Terrestrial Networks

### 16.14.1 Overview

Figures 16.14.1-1 and 16.14.1-X below illustrate examples of a Non-Terrestrial Network (NTN) providing non-terrestrial NR access to the UE by means of an NTN payload and an NTN Gateway, depicting a service link between the NTN payload and a UE, and a feeder link between the NTN Gateway and the NTN payload. In Figure 16.14.1-1 the payload is transparent; in Figure 16.14.1-X the payload is regenerative and hosts a gNB.



Figure 16.14.1-1: Overall illustration of an NTN with transparent payload



Figure 16.14.1-X: Overall illustration of an NTN with regenerative payload hosting a gNB

NOTE 1: Figures 16.14.1-1 and 16.14.1-X illustrate an NTN; RAN4 aspects are out of scope.

The NTN transparent payload transparently forwards the radio protocol received from the UE (via the service link) to the NTN Gateway (via the feeder link) and vice-versa. The regenerative payload terminates the Uu interface toward the UE (via the service link), and the NG interface toward the 5GC (via the feeder link). The following connectivity is supported by the NTN payload:

Editor’s Note: The above section needs further checking.

- An NTN gateway may serve multiple transparent or regenerative NTN payloads;

- A transparent or regenerative NTN payload may be served by multiple NTN gateways;

- A regenerative NTN payload may terminate one or more inter-satellite links toward other regenerative payloads;

- The feeder link is a transport link; it may transport the NG interface between the 5GC and the gNB hosted by the regenerative payload;

- The inter-satellite link is a transport link; it may transport the Xn interface between the gNBs hosted by the two regenerative payloads.

NOTE 2: In this release, the transparent NTN-payload may change the carrier frequency, before re-transmitting it on the service link, and vice versa (respectively on the feeder link).

For NTN, the following applies in addition to Network Identities as described in clause 8.2:

- A Tracking Area corresponds to a fixed geographical area. Any respective mapping is configured in the RAN;

- A Mapped Cell ID as specified in clause 16.14.5.

Three types of service links are supported:

- Earth-fixed: provisioned by beam(s) continuously covering the same geographical areas all the time (e.g., the case of GSO satellites);

- Quasi-Earth-fixed: provisioned by beam(s) covering one geographic area for a limited period and a different geographic area during another period (e.g., the case of NGSO satellites generating steerable beams);

- Earth-moving: provisioned by beam(s) whose coverage area slides over the Earth surface (e.g., the case of NGSO satellites generating fixed or non-steerable beams).

With NGSO satellites, the gNB can provide either quasi-Earth-fixed service link or Earth-moving service link, while gNB operating with GSO satellite can provide Earth fixed service link or quasi-Earth-fixed service link.

In this release, the UE supporting NTN is GNSS-capable.

In NTN, the distance refers to Euclidean distance.

**NEXT CHANGE**

### 16.14.4 Switchover

#### 16.14.4.1 Definitions

A feeder link switchover is the procedure where the feeder link is changed from a source NTN Gateway to a target NTN Gateway for an NTN payload. The feeder link switchover is a Transport Network Layer procedure. Service link switch refers to a change of the serving NTN payload.

Both hard and soft feeder link switchover are supported in NTN for any payload.

#### 16.14.4.2 Assumptions

A feeder link switch over may result in transferring the established connection for the affected UEs between two gNBs.

For soft feeder link switch over, an NTN payload is able to connect to more than one NTN Gateway during a given period, i.e. a temporary overlap can be ensured during the transition between the feeder links.

For hard feeder link switch over, an NTN payload connects to only one NTN Gateway at any given time, i.e. a radio link interruption may occur during the transition between the feeder links.

#### 16.14.4.3 Procedures

The NTN Control function (see Annex B.4) determines the point in time when the feeder link switch over between two gNBs is performed. The transfer of the affected UE(s)' context between the two gNBs at feeder link switch over is performed by means of either NG based or Xn based handover, and it depends on the gNBs' implementation and configuration information provided to the gNBs by the NTN Control function.

**NEXT CHANGE**

**INFORMATIVE: RAN2 MAY EXPECT RAN3 TO REVIEW THIS PART – NO CHANGE**

### 16.14.6 AMF (Re-)Selection

The gNB implements the NAS Node Selection Function specified in TS 38.410 [16].

For an RRC\_CONNECTED UE, when the gNB is configured to ensure that the UE connects to an AMF that serves the country in which the UE is located, if the gNB detects that the UE is in a different country to that served by the serving AMF, then it should perform an NG handover to change to an appropriate AMF, or initiate an UE Context Release Request procedure towards the serving AMF (in which case the AMF may decide to de-register the UE).

For the purpose of selecting an appropriate AMF, the 5GC may verify the UE location according to TS 23.501 [3] and TS 38.305 [42] after the UE has attached to the network.

NOTE: UE location verification for AMF selection should not be necessary if NTN cell(s) do not extend across countries.

**NEXT CHANGE**

# B.4 Example implementation of Non-Terrestrial Networks

The following figure illustrates an example implementation of a Non-Terrestrial Network for transparent NTN payload:



Figure B.4-1: NTN based NG-RAN with transparent NTN payload

The gNB depicted in Figure B.4-1 may be subdivided into non-NTN infrastructure gNB functions and the NTN Service Link provisioning system. The NTN infrastructure may be thought of being subdivided into the NTN Service Link provisioning system and the NTN Control function. The NTN Service Link provisioning system may consist of one or more NTN payloads and NTN Gateways.

The NTN payload is embarked on a spaceborne (or airborne) vehicle, providing a structure, power, commanding, telemetry, attitude control for the satellite (resp. HAPS) and possibly an appropriate thermal environment, radiation shielding.

The NTN Service Link provisioning system maps the NR-Uu radio protocol over radio resources of the NTN infrastructure (e.g. beams, channels, Tx power).

The NTN control function controls the spaceborne (or airborne) vehicles as well as the radio resources of the NTN infrastructure (NTN payload(s) & NTN Gateway(s)). It provides control data, e.g. Ephemeris, to the non-NTN infrastructure gNB functions of the gNB.

Provision of NTN control data to the gNB is out of 3GPP scope.

NOTE: The transport of NR-Uu protocol between the NTN Service Link provisioning system and the non-NTN infrastructure gNB functions is out of 3GPP scope.

At least the following NTN related parameters are expected to be provided by O&M to the gNB for its operation:

a) Earth-fixed beams: for each beam provided by a given NTN-payload:

- The Cell identifier (NG and Uu) mapped to the beam;

- The Cell's reference location (e.g. cell's center and range).

b) Quasi-Earth-fixed: for each beam provided by a given NTN payload:

- The Cell identifier (NG and Uu) and time window mapped to a beam;

- The Cell's/beam's reference location (e.g. cell's center and range);

- The time window of the successive switch overs (feeder link, service link);

- The identifier and time window of all serving satellites (resp. HAPS) and NTN Gateways.

c) Earth moving beams: for each beam provided by a given NTN payload:

- The Uu Cell identifier mapped to a beam and mapping information to fixed geographical areas reported on NG, including information about the beams direction and motion of the beam's foot print on Earth;

- Its elevation wrt NTN payload;

- Schedule of successive serving NTN Gateways/gNBs;

- Schedule of successive switch overs (feeder link, service link).

**END OF CHANGES**