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Title: Clarifications to the Use Case on NTN-based dual 3GPP access

Agenda Item: 7.9.1 FS\_DualSteer

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*Abstract: this document introduces corrections to the use case addressing NTN based dual 3GPP access connectivity, to be captured in TR 22.841 v.2.1.0.*

*The corrections aim to clarify that the benefits of Dualsteer are not only in the experience of individual users, but also in improving overall network performance and capacity and/or reducing cost-per-bit to deliver services.*

\* \* \* First Change \* \* \* \*

## Use case on NTN-based dual 3GPP access

### 5.5.1 Description

Aggregating two 3GPP access links simultaneously, of which one is non-terrestrial network, can provide the following 5G service enablers, relevant especially in underserved areas, characterized by limited bandwidth or un-reliable access link:

* Extended Mobile Broadband
* Ultra Reliable service communications

As indicated in TR 38.821, a number of service scenarios (e.g. user in residential homes in remote areas, users on board vehicles, high speed trains, vessels or airplanes), would benefit from the combination of terrestrial and non-terrestrial access or two different non-terrestrial access (e.g. GSO and NGSO based) to meet the targeted service performances in terms of data rate and/or reliability.

The operator of the multi orbit network will also benefit from the flexibility brought by such combination techniques in the optimisation of the network resource usage. The ability to offload delay tolerant traffic components to a GSO access increases the NGSO access network’s capacity for delay sensitive traffic. Moreover, the operator can reduce the service delivery cost where GSO and NGSO access networks have different cost per bit transported.

In underserved areas, the bandwidth provided by a terrestrial based access (e.g. NR or LTE) may be limited at cell edge. Adding a NTN based NG-RAN will be an enable to achieve the targeted experience data rate.

Under some scenarios such as on board high speed trains, the service area may not be fully homogeneous along the rail track and multi connectivity involving NTN-based NG-RAN would enable to provide the targeted reliability.

Hence a UE may be connected and served simultaneously by:

* One NTN-based 3GPP access and one terrestrial-based 3GPP access
* One NTN-based 3GPP access (NGSO) and another NTN-based 3GPP access (GSO)
* One NTN-based 3GPP access (NGSO) via two different satellites of the same constellation

The dual access combining can occur for either the uplink or the downlink or both.

The same or different gNB could serve NR cells via the terrestrial access network and via the satellite access network (e.g. with transparent payload on board the satellite).

NTN based NG-RAN may refer to transparent payload satellites as well as regenerative payload satellites with, for example, some gNB functions on board.

In the following are illustrated:

a) Multi connectivity involving transparent payload NTN-based NG-RAN and terrestrial NG-RAN

A User Equipment is connected to a 5GCN via simultaneously a transparent NTN-based NG-RAN and a cellular NG-RAN. We assume that the NTN Gateway is located in the PLMN area of the cellular access network.

The two following cases can be considered:

Both PLMNs are managed by different operators (It is assumed that they have a business agreement among them);



Figure 5.5.1a: Multi connectivity involving transparent NTN-based NG-RAN and cellular NG-RAN different PLMN)

Both PLMNs are managed by the same operator.



Figure 5.5.1b: Multi connectivity involving transparent NTN-based NG-RAN and cellular NG-RAN (same PLMN)

b) Multi connectivity involving two transparent NTN-based NG-RAN access

This refers for example to the combination of two Transparent NTN-based NG-RANs e.g. GSO and NGSO based. This can be of interest to provide service to UEs in unserved areas. The NGSO based NG-RAN featuring relatively low latency can be used to support the delay sensitive traffic while the GSO based NG-RAN would provide additional bandwidth to meet the targeted throughput requirements. This is depicted in the figure below.



Figure 5.5.2: Multi connectivity between two transparent NTN-based NG-RAN

c) The combination of two regenerative NTN-based NG-RAN (gNB on board) via two satellites of same constellation with Inter Satellite Links in between. This is depicted in the figure below.



Figure 5.5.3: Multi connectivity between two regenerative NTN-based NG-RAN (e.g. gNB on board)

Note that

* the figure 5.5.3 is for illustrative purposes. Other architecture (e.g. split NG-RAN architecture between satellite and ground) may be considered;
* SRI refers to satellite radio interface in the figure 5.5.3.

### 5.5.2 Pre-conditions

There shall be some coverage overlap between both NG-RAN access link involved.

In case of same PLMN for both access links, the UE is attached to the 5GC serving both access links.

The 5GC is aware of the respective characteristics of both access links.

In case of different PLMN for the respective access links, UE is subscribed to HPLMN and get access also to the other network through roaming agreement. Information about the respective characteristics of the access links may be exchanged between both networks.

The UE is in connected mode on at least one of the access links.

A slice can be deployed and managed over both access links.

### 5.5.3 Service Flows

The UE establish a VoIP, a video or a data service over one 3GPP access link which appears insufficient in QoS (e.g. throughput, latency, etc.). Given that another 3GPP access link is available, it is activated and combined with the first one to support the required QoS of the service.

According to the targeted QoS of the service, the user plane traffic of the connectivity can be smartly steered, splitted and switched in both directions between both 3GPP NG-RAN access links taking into account the specific performances of each access link, for example, in terms of latency, throughput, Jitter, Error rate.

The QoS requirements of the user plane traffic can be determined through specific policies associated to different data flows, or different traffic type within the same data flow.

Based on the QoS requirements (e.g. latency, throughput, Jitter, Error rate), traffic characteristics, radio links conditions and UE's moving speed, the traffic is steered/splitted across the access links. For example low latency requirement traffic will be best splitted/steered to the access link featuring the lowest latency characteristics.

In case of hand-over, temporary radio link failure or congestion on one access link, the user plane traffic can be switched to the remaining active access link. When the radio link is re-established, the user plane is again splitted/steered across both access links based on QoS.

The reported data volumes and other traffic statistics, on each access link, are used for billing purposes.

### 5.5.4 Post-conditions

Thanks to appropriate steering, splitting and switching of the user plane traffic, the dual NG-RAN access connectivity involving at least NTN can support the targeted QoS that a single access cannot support. The operator of the multi-orbit network can leverage its GSO access network to increase the capacity of its NGSO access network for delay sensitive and/or optimise the service cost. A network-native standard approach ensures operators can manage the feature in a consistent manner across all users and applications, balancing the needs of individuals with those of the network as a whole.

### 5.5.5 Existing features partly or fully covering the use case functionality

The use case can leverage and extend some of the existing service requirements, e.g. related to

* Multiple access technologies (see §6.3 of TS 22.261)
* Multi-network connectivity and service delivery across operators (see §6.18 of TS 22.261)
* NW Slices (see §6.1 of TS 22.261)
* Efficient user plane (see §6.5 of TS 22.261)

### 5.5.6 Potential New Requirements needed to support the use case

[PR 5.5.6-001] Based on operator policy, the 5G system shall be able to support mechanisms to configure and control the steering of UE’s simultaneous service data flows (of the same service session) across two 3GPP access networks (e.g. NGSO and GSO), and optimally distribute user traffic between the two access networks, taking into account connectivity characteristics on both access networks (e.g. radio characteristics, mobility, congestion) and UE's moving speed.

[PR 5.5.6-002] When two 5G access networks are used simultaneously for the same service session, the 5G system shall be able to collect charging information, for both links simultaneously.

NOTE: In case the two 5G access networks belong to different PLMNs, single subscription and data anchoring in the HPLMN 5G CN are assumed.

[PR 5.5.6-003] A UE can be configured by the network operator to use traffic steering (over two 3GPP access networks) for certain services, while other applications or services may use a single 3GPP access link.

\* \* \* End of Changes \* \* \* \*