**SA WG2 Meeting #S2-147ES2-2107429r02**

**18 - 22 October, 2021, Electronic meeting** (revision of S2-2106073)

**Source: CATT**

**Title: New SID on Study on Support of Satellite Backhauling in 5GS**

**Document for: Approval**

**Agenda Item: 9.1.3**

3GPP™ Work Item Description

Information on Work Items can be found at <http://www.3gpp.org/Work-Items>   
See also the [3GPP Working Procedures](http://www.3gpp.org/specifications-groups/working-procedures), article 39 and the TSG Working Methods in [3GPP TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm)

Title: Study on Support of Satellite Backhauling in 5GS

Acronym: FS\_5GSATB

Unique identifier: TBD

Potential target Release: Rel-18

# 1 Impacts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Affects: | UICC apps | ME | AN | CN | Others (specify) |
| Yes |  | X | X | X |  |
| No | X |  |  |  |  |
| Don't know |  |  |  |  | X |

# 2 Classification of the Work Item and linked work items

## 2.1 Primary classification

### This work item is a …

|  |  |
| --- | --- |
|  | Feature |
|  | Building Block |
|  | *Work Task* |
| X | Study Item |

## 2.2 Parent Work Item

For a brand-new topic, use “N/A” in the table below. Otherwise indicate the parent Work Item.

|  |  |  |  |
| --- | --- | --- | --- |
| Parent Work / Study Items | | | |
| Acronym | Working Group | Unique ID | Title (as in 3GPP Work Plan) |
| 5GSATB | SA1 | 920035 | 5G system with satellite backhaul |

### 2.3 Other related Work Items and dependencies

|  |  |  |
| --- | --- | --- |
| Other related Work /Study Items (if any) | | |
| Unique ID | Title | Nature of relationship |
| 800026 | Study on architecture aspects for using satellite access in 5G | SA2 Rel-17 SID for 5GS architecture using satellite access |
| 890034 | Integration of satellite components in the 5G architecture | SA2 Rel-17 WID for 5GS architecture using satellite access |
|  |  |  |

# 3 Justification

Since satellites can provide mobile broad band access to mobile users with continuous coverage, they are used by MNOs to provide backhaul service for gNBs in fringe areas (e.g. remote rural areas) and in cases of emergency or temporary measure (e.g. a disaster area or in place of a microwave link whilst waiting for licence approval). As indicated by GSMA, the satellite backhaul is used in developing markets and as a complementary role in developed markets.

In Rel-17, satellite backhaul connection for 5GS is studied. However the study is mainly focusing on the basic case where only one satellite (GEO or NGSO satellite) is involved in for both CP and UP backhaul connections. The enhancements to support satellite backhaul in 5GS include:

- Detecting satellite backhaul category based on network configuration;

- Event report to PCF on change of the backhaul;

- Policy determination based on satellite backhaul category;

- Notifying the AF on changes of the satellite backhaul category.

The following cases of using satellite backhaul connection for 5GS have not been studied in Rel-17:

- gNB connects to 5GC via satellites with ISL(inter-satellite link);

- gNB connects to 5GC with hybrid backhauls (e.g., satellite and terrestrial backhauls, or different types of satellite backhauls);

- gNB has discontinuous backhaul.

In these cases, existing enhancements may not work or need to be adjusted, because:

- If ISL is involved in the backhaul connection, the satellite backhaul category can not be determined only based on network configuration (e.g. if a ISL between LEO and GEO is involved), and can not represent the latency over the satellite backhaul as delay introduced by multi-hops of ISL may largely contribute to whole backhaul latency), which makes the PCF and AF not know whether existing QoS requirements can be met;

- If the backhaul connection of a gNB is changed, e.g. between satellite and terrestrial backhauls, between different types of satellite backhauls, or between satellite backhaul with ISL and feeder link, the gNB may be subject to service interruption, or UP connection lost if gNB IP address changes.

- If a gNB has discontinuous backhaul, e.g. due to discontinuous satellite beam projected by sparse satellite constellation, there will be interruptions for signalling/data transmission.

Satellite link may have long packet delivery latency and limited bandwidth, so when satellite backhaul is used for a UE, it would be beneficial to shorten the backhaul connection, e.g. via providing EC(edge computing) service or enabling local switching on the satellite. According to current architectural requirements of supporting EC or local switching on the satellite, a UPF needs to be deployed on the satellite, which requires enhancing 5GS to support UPF on-board. Furthermore, to provide EC services (e.g. computing service for IoT applications), it is also required to deploy EC server(s) on the satellite.

# 4 Objective

The objectives of this SA2 study are to study the cases of 5GS using different backhaul connections which are not covered in Rel-17, and the potential enhancements to 5GS to support these cases, taking into account of different backhaul characteristics (e.g. dynamic delay, limited bandwidth), which include the following aspects:

WT#1: Architecture enhancements for support of a backhaul with changing delay (e.g. brought by ISL in satellite networks or changed satellite backhaul on the UP path) and/or limited bandwidth (e.g., restricted by the maximum data rate of a satellite beam):

WT#1.1: Policy/QoS control enhancements based on the detected packet delivery latency and/or bandwidth of the satellite backhaul on the UP path;

WT#1.2: Exposure of backhaul information to AFs.

WT#2: Architecture enhancements for support of a gNB with multi-types of backhauls:

WT#2.1: Protocol adaption on N1/N2 interface by taking the characteristics of each TNLA (e.g. latency) into account;

WT#2.2: UP path management in case of backhaul connection change, especially when gNB IP address changes (e.g. changing backhaul connections between terrestrial network and satellite network).

NOTE 1: How to detect the characteristics of each TNLA (e.g. latency) and backhaul connection change are expected to require RAN work.

NOTE 2: Whether WT#2.2 will be included depends on RAN conclusion, if yes, it is expected to have a gap analysis to determine whether existing mechanism can solve the above issues during the study phase.

WT#3: Architecture enhancements for support of a gNB with discontinuous backhaul caused by sparse satellite constellation:

WT#3.1: N2 connection maintenance in case of predictable backhaul connection loss;

WT#3.2: Data transmission enhancement to accommodate predictable backhaul connection loss;

WT#3.3: Reliable signalling transmission in case of predictable backhaul connection loss.

NOTE 3: Whether and how to keep N2 connection in case of temporary backhaul connection loss is expected to require RAN work. Correlation with the study for discontinuous coverage needs to be considered during the study.

WT#4: Architecture enhancements for support of UPF deployed on GEO satellite:

WT#4.1: UPF selection and re-selection.

WT#4.2: Support of local switching for 5G VN in UPF for UEs in a communication.

WT#4.3: Support of N19 forwarding for 5G VN for UEs in a communication.

NOTE 4: Support of UPF deployed on NGSO satellite and local switching for general cases are to be considered in the future release.

Potential NG interface impacts to RAN will be coordinated with RAN WGs.

## TU estimates and dependencies

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Work Task ID** | **TU Estimate**  **(Study)** | **TU Estimate**  **(Normative)** | **RAN Dependency**  **(Yes/No/Maybe)** | **Inter Work Tasks Dependency** |
| WT#1 |  |  |  | WT#1 is self-contained. |
| >WT#1.1 | 0.5 | 0.25 | No |  |
| >WT#1.2 | 0.5 | 0.25 | No |  |
| WT#2 |  |  |  | WT#2 is self-contained. |
| >WT#2.1 | 0.5 | 0.25 | Yes |  |
| >WT#2.2 | 1 | 0.5 | Yes |  |
| WT#3 |  |  |  | WT#3 is self-contained. |
| >WT#3.1 | 0.5 | 0.25 | Yes |  |
| >WT#3.2 | 0.5 | 0.25 | Maybe |  |
| >WT#3.3 | 0.5 | 0.25 | Maybe |  |
| WT#4 |  |  |  | WT#4 is self-contained. |
| >WT#4.1 | 1 | 0.5 | No |  |
| >WT#4.2 | 1 | 0.75 | No |  |
| >WT#4.3 | 1 | 0.75 | No |  |

**Total TU estimates for the study phase: 7**

**Total TU estimates for the normative phase: 4**

**Total TU estimates: 7 + 4 = 11**

# 5 Expected Output and Time scale

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| New specifications {One line per specification. Create/delete lines as needed} | | | | | |
| Type | TS/TR number | Title | For info  at TSG# | For approval at TSG# | Rapporteur |
| Internal TR | 23.XXX | Study on support of satellite backhauling in 5GS | TSG#98 | TSG#99 |  |
|  |  |  |  |  |  |

{Note 1: Only TSs may contain normative provisions. Study Items shall create or impact only TRs.  
"Internal TR" is intended for 3GPP internal use only whereas "External TR" may be transposed by OPs.}

{Note 2: The first listed Rapporteur is the specification primary Rapporteur. Secondary Rapporteur(s) are possible for particular aspect(s) of the TS/TR. In this case, their responsibility has to be provided as "Remarks".}

|  |  |  |  |
| --- | --- | --- | --- |
| Impacted existing TS/TR {One line per specification. Create/delete lines as needed} | | | |
| TS/TR No. | Description of change | Target completion plenary# | Remarks |
|  |  |  |  |
|  |  |  |  |

# 6 Work item Rapporteur(s)

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{The first listed Rapporteur is the work item primary Rapporteur. The role of a Rapporteur is further described in [www.3gpp.org/specifications-groups/delegates-corner/writing-a-new-spec](http://www.3gpp.org/specifications-groups/delegates-corner/writing-a-new-spec). By default, the primary Rapporteur shall ensure the production of the post-completion summary.   
Secondary Rapporteur(s) are possible for specific secondary task(s), such as: "Write the post-completion summary"; "In charge of a specific aspect of the work item (specify which)"; "Rapporteur for a secondary responsible WG (specify which)"}

# 7 Work item leadership

SA2.

# 8 Aspects that involve other WGs

SA3 for the Security aspects, SA5 for the Charging aspects.

Coordination with RAN WG is expected.

# 9 Supporting Individual Members

|  |
| --- |
| Supporting IM name |
| CATT |
| China Mobile |
| China Telecom |
| China Unicom |
| Huawei |
| Vivo |
| Tencent |
| Thales |
| ZTE |
| ESA |
| Avanti |
| Gatehouse |
| Intelsat |
| Ligado |
| TNO |
| Novamint |
| Gilat Satelite networks Ltd |
| Inmarsat |
| Hispasat |
|  |