**SA WG2 Meeting SA2#165 S2-240xxxx**

**14-18, October 2024, Hyderabad, IN (Revision of S2-2408675)**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **501** | **CR** | **5622** | **rev** | **-** | **Current version:** | **19.1.0** |  |
|  | | | | | | | | |
| *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 |  | Core Network | **X** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | Support of Regenerative Payload with NG-RAN Node Onboard Satellite | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | OPPO, Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | SA2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | 5GSAT\_Ph3\_ARCH | | | | |  | ***Date:*** | | | 2024-08-08 |
|  |  | | | |  | |  | | |  |
| ***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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | 5GSAT\_Ph3\_ARCH introduces support of satellite access with regenerative payload which has impacts to N2 connection management and NFs determining its use based on RAN node IDs (e.g. by the AMF or PCF).  The 5QI values for regenerative satellite access have the same overall requirements (as the traffic still travels between the ground-satellite-ground), but the split of budget between the Uu and CN for the PDB is different. So additional informaiton about this is required.  RAN transitioning between different NTN GWs, TAIs and potentially between MMEs/AMFs can be supported by using existing procedures, e.g. the eNB/gNB releasing UEs to (E)CM\_IDLE before changing NTN gateway, or by using existing load balancing, trigger handover when it realizes it is going to leave a tracking area due to its own movement, etc.  Relevant text needs to be updated in TS 23.501. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | NOTE 1 for AMF load balancing is extended to reflect the above conclusion in TS 23.700-29  Introduce the impact that regenerative-based satellite access brought to N2 connection management and not how NFs can determine its use.  Add NOTE about different CN PDB for regenerative satellite access. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Regenerative-based satellite access operation is not supported, and lack of clarification of using AMF load balancing when NG-RAN node onboard satellite. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.4.11.1, 5.4.11.2, 5.4.11.x (new), 5.7.4, 6.2.1, 6.3.5 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | |  | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

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

### 5.19.3 AMF Load Balancing

The AMF Load Balancing functionality permits UEs that are entering into an AMF Region/AMF Set to be directed to an appropriate AMF in a manner that achieves load balancing between AMFs. This is achieved by setting a Weight Factor for each AMF, such that the probability of the 5G-AN selecting an AMF is proportional to Weight Factor of the AMF. The Weight Factor is typically set according to the capacity of an AMF node relative to other AMF nodes. The Weight Factor is sent from the AMF to the 5G-AN via NGAP messages (see TS 38.413 [34]).

NOTE 1: An operator may decide to change the Weight Factor after the establishment of NGAP connectivity as a result of changes in the AMF capacities. e.g. a newly installed AMF may be given a very much higher Weight Factor for an initial period of time making it faster to increase its load.

NOTE 2: It is intended that the Weight Factor is NOT changed frequently. e.g. in a mature network, changes on a monthly basis could be anticipated, e.g. due to the addition of 5G-AN or 5GC nodes.

NOTE 3: Weight Factors for AMF Load Balancing are associated with AMF Names.

Load balancing by 5G-AN node is only performed between AMFs that belong to the same AMF set, i.e. AMFs with the same PLMN, AMF Region ID and AMF Set ID value.

The 5G-AN node may have their Load Balancing parameters adjusted (e.g. the Weight Factor is set to zero if all subscribers are to be removed from the AMF, which will route new entrants to other AMFs within an AMF Set).

\*\*\*\*\* Second Change \*\*\*\*\*

### 5.4.11 Support for integrating NR satellite access into 5GS

#### 5.4.11.1 General

This clause describes the specific aspects for NR satellite access, including transparent satellite payloads and regenerative satellite payloads.

\*\*\*\*\* Third Change \*\*\*\*\*

#### 5.4.11.2 Support of RAT types defined in 5GC for satellite access

In case of NR satellite access, the RAT Types values "NR(LEO)", "NR(MEO)", "NR(GEO)" and "NR(OTHERSAT)" are used in 5GC to distinguish the different NR satellite access types (see clause 5.4.10).

When a UE is accessing to the network via satellite access, the AMF determines the RAT type as specified in clause 5.4.10.

NOTE: There is no differentiation of whether the RAT type is a transparent satellite payload or a regenerative satellite payload. The e.g. Global RAN Node IDs associated with satellite payload can be used to determine whether the UE is accessing via transparent or regenerative satellite payload, if needed, by e.g. the AMF, SMF, PCF, etc.

\*\*\*\*\* Fourth Change \*\*\*\*\*

#### 5.4.11.X N2 connection management for regenerative satellite payload

The NG Removal procedure defined in TS 38.413 [34] can be used to remove the interface between a gNB and an AMF in a controlled manner, e.g. when the gNB is leaving the service area of an AMF.

When the feeder-link for an NG-RAN node changes to allow the serving AMF for a UE to change then e.g. the AN Release procedure, or AMF Load Balancing (see clause 5.19.3) with setting the Weight Factor of the AMFs, or intra-NG-RAN node handover (see clause 4.9.1 of TS 23.502 [3]) may be performed for UEs in CM\_CONNECTED.NOTE: If the TAC value changes as the cell moves across the Earth’s surface (see clause 5.4.11.7) then the UE will initiate a Registration procedure as defined in clause 4.2.2.2.1 of TS 23.502 [3].

\*\*\*\*\* Fifth Change \*\*\*\*\*

### 5.7.4 Standardized 5QI to QoS characteristics mapping

Standardized 5QI values are specified for services that are assumed to be frequently used and thus benefit from optimized signalling by using standardized QoS characteristics. Dynamically assigned 5QI values (which require a signalling of QoS characteristics as part of the QoS profile) can be used for services for which standardized 5QI values are not defined. The one-to-one mapping of standardized 5QI values to 5G QoS characteristics is specified in table 5.7.4-1.

Table 5.7.4-1: Standardized 5QI to QoS characteristics mapping

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 5QI  Value | Resource Type | Default Priority Level | Packet Delay Budget  (NOTE 3) | Packet Error  Rate | Default Maximum Data Burst Volume  (NOTE 2) | Default  Averaging Window | Example Services |
| 1 | GBR | 20 | 100 ms  (NOTE 11,  NOTE 13) | 10-2 | N/A | 2000 ms | Conversational Voice |
| 2 | (NOTE 1) | 40 | 150 ms  (NOTE 11,  NOTE 13) | 10-3 | N/A | 2000 ms | Conversational Video (Live Streaming) |
| 3 |  | 30 | 50 ms  (NOTE 11,  NOTE 13) | 10-3 | N/A | 2000 ms | Real Time Gaming, V2X messages (see TS 23.287 [121]).  Electricity distribution – medium voltage, Process automation monitoring |
| 4 |  | 50 | 300 ms  (NOTE 11,  NOTE 13) | 10-6 | N/A | 2000 ms | Non-Conversational Video (Buffered Streaming) |
| 65  (NOTE 9,  NOTE 12) |  | 7 | 75 ms  (NOTE 7, NOTE 8) | 10-2 | N/A | 2000 ms | Mission Critical user plane Push To Talk voice (e.g. MCPTT) |
| 66  (NOTE 12) |  | 20 | 100 ms  (NOTE 10,  NOTE 13) | 10-2 | N/A | 2000 ms | Non-Mission-Critical user plane Push To Talk voice |
| 67  (NOTE 12) |  | 15 | 100 ms  (NOTE 10,  NOTE 13) | 10-3 | N/A | 2000 ms | Mission Critical Video user plane |
| 75  (NOTE 14) |  | 25 | 50 ms  (NOTE 13) | 10-2 | N/A | 2000 ms | V2X messages (see TS 23.287 [121]).  A2X messages (see TS 23.256 [136]) |
| 71 |  | 56 | 150 ms (NOTE 11, NOTE 13, NOTE 15) | 10-6 | N/A | 2000 ms | "Live" Uplink Streaming (e.g. TS 26.238 [76]) |
| 72 |  | 56 | 300 ms (NOTE 11, NOTE 13, NOTE 15) | 10-4 | N/A | 2000 ms | "Live" Uplink Streaming (e.g. TS 26.238 [76]) |
| 73 |  | 56 | 300 ms (NOTE 11, NOTE 13, NOTE 15) | 10-8 | N/A | 2000 ms | "Live" Uplink Streaming (e.g. TS 26.238 [76]) |
| 74 |  | 56 | 500 ms (NOTE 11, NOTE 15) | 10-8 | N/A | 2000 ms | "Live" Uplink Streaming (e.g. TS 26.238 [76]) |
| 76 |  | 56 | 500 ms (NOTE 11, NOTE 13, NOTE 15) | 10-4 | N/A | 2000 ms | "Live" Uplink Streaming (e.g. TS 26.238 [76]) |
| 5 | Non-GBR | 10 | 100 ms  (NOTE 10,  NOTE 13) | 10-6 | N/A | N/A | IMS Signalling |
| 6 | (NOTE 1) | 60 | 300 ms  (NOTE 10,  NOTE 13) | 10-6 | N/A | N/A | Video (Buffered Streaming)  TCP-based (e.g. www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.), AI/ML model download for image recognition (e.g. for model topology) (see TS 22.261 [2]) |
| 7 |  | 70 | 100 ms  (NOTE 10,  NOTE 13) | 10-3 | N/A | N/A | Voice,  Video (Live Streaming)  Interactive Gaming, AI/ML model download for image recognition (e.g. for model weight factors) (see TS 22.261 [2]) |
| 8 |  | 80 | 300 ms  (NOTE 10, NOTE 13) | 10-6 | N/A | N/A | Video (Buffered Streaming)  TCP-based (e.g. www, e-mail, chat, ftp, p2p file sharing, progressive |
| 9 |  | 90 |  |  |  |  | video, etc.) |
| 10 |  | 90 | 1100ms  (NOTE 10,NOTE 13, NOTE 17,  NOTE X) | 10-6 | N/A | N/A | Video (Buffered Streaming)  TCP-based (e.g. www, e-mail, chat, ftp, p2p file sharing, progressive video, etc.) and any service that can be used over satellite access type with these characteristics |
| 69  (NOTE 9, NOTE 12) |  | 5 | 60 ms  (NOTE 7, NOTE 8) | 10-6 | N/A | N/A | Mission Critical delay sensitive signalling (e.g. MC-PTT signalling) |
| 70  (NOTE 12) |  | 55 | 200 ms  (NOTE 7,  NOTE 10) | 10-6 | N/A | N/A | Mission Critical Data (e.g. example services are the same as 5QI 6/8/9) |
| 79 |  | 65 | 50 ms  (NOTE 10,  NOTE 13) | 10-2 | N/A | N/A | V2X messages (see TS 23.287 [121]) |
| 80 |  | 68 | 10 ms  (NOTE 5,  NOTE 10) | 10-6 | N/A | N/A | Low Latency eMBB applications Augmented Reality |
| 82 | Delay-critical GBR | 19 | 10 ms (NOTE 4) | 10-4 | 255 bytes | 2000 ms | Discrete Automation (see TS 22.261 [2]) |
| 83 |  | 22 | 10 ms (NOTE 4) | 10-4 | 1354 bytes  (NOTE 3) | 2000 ms | Discrete Automation (see TS 22.261 [2]);  V2X messages (UE - RSU Platooning, Advanced Driving: Cooperative Lane Change with low LoA. See TS 22.186 [111], TS 23.287 [121]) |
| 84 |  | 24 | 30 ms  (NOTE 6) | 10-5 | 1354 bytes  (NOTE 3) | 2000 ms | Intelligent transport systems (see TS 22.261 [2]) |
| 85 |  | 21 | 5 ms  (NOTE 5) | 10-5 | 255 bytes | 2000 ms | Electricity Distribution- high voltage (see TS 22.261 [2]).  V2X messages (Remote Driving. See TS 22.186 [111], NOTE 16, see TS 23.287 [121]).  Split AI/ML inference - DL Split AI/ML image recognition, (see TS 22.261 [2]) |
| 86 |  | 18 | 5 ms  (NOTE 5) | 10-4 | 1354 bytes | 2000 ms | V2X messages (Advanced Driving: Collision Avoidance, Platooning with high LoA. See TS 22.186 [111], TS 23.287 [121]) |
| 87 |  | 25 | 5 ms (NOTE 4) | 10-3 | 500 bytes | 2000 ms | Interactive Service - Motion tracking data, (see TS 22.261 [2]) |
| 88 |  | 25 | 10 ms (NOTE 4) | 10-3 | 1125 bytes | 2000 ms | Interactive Service - Motion tracking data, (see TS 22.261 [2]), split AI/ML inference - UL Split AI/ML image recognition, (see TS 22.261 [2]) |
| 89 |  | 25 | 15 ms (NOTE 4) | 10-4 | 17000 bytes | 2000 ms | Visual content for cloud/edge/split rendering (see TS 22.261 [2]) |
| 90 |  | 25 | 20 ms (NOTE 4) | 10-4 | 63000 bytes | 2000 ms | Visual content for cloud/edge/split rendering (see TS 22.261 [2]) |
| NOTE 1: A packet which is delayed more than PDB is not counted as lost, thus not included in the PER.  NOTE 2: It is required that default MDBV is supported by a PLMN supporting the related 5QIs.  NOTE 3: The Maximum Transfer Unit (MTU) size considerations in clause 9.3 and Annex J are also applicable. IP fragmentation may have impacts to CN PDB, and details are provided in clause 5.6.10.  NOTE 4: A static value for the CN PDB of 1 ms for the delay between a UPF terminating N6 and a 5G-AN should be subtracted from a given PDB to derive the packet delay budget that applies to the radio interface. When a dynamic CN PDB is used, see clause 5.7.3.4.  NOTE 5: A static value for the CN PDB of 2 ms for the delay between a UPF terminating N6 and a 5G-AN should be subtracted from a given PDB to derive the packet delay budget that applies to the radio interface. When a dynamic CN PDB is used, see clause 5.7.3.4.  NOTE 6: A static value for the CN PDB of 5 ms for the delay between a UPF terminating N6 and a 5G-AN should be subtracted from a given PDB to derive the packet delay budget that applies to the radio interface. When a dynamic CN PDB is used, see clause 5.7.3.4.  NOTE 7: For Mission Critical services, it may be assumed that the UPF terminating N6 is located "close" to the 5G\_AN (roughly 10 ms) and is not normally used in a long distance, home routed roaming situation. Hence a static value for the CN PDB of 10 ms for the delay between a UPF terminating N6 and a 5G\_AN should be subtracted from this PDB to derive the packet delay budget that applies to the radio interface.  NOTE 8: In RRC\_IDLE, RRC\_INACTIVE and RRC\_CONNECTED mode, the PDB requirement for these 5QIs can be relaxed (but not to a value greater than 320 ms) for the first packet(s) in a downlink data or signalling burst in order to permit reasonable battery saving (DRX) techniques.  NOTE 9: It is expected that 5QI-65 and 5QI-69 are used together to provide Mission Critical Push to Talk service (e.g. 5QI-5 is not used for signalling). It is expected that the amount of traffic per UE will be similar or less compared to the IMS signalling.  NOTE 10: In RRC\_IDLE, RRC\_INACTIVE and RRC\_CONNECTED mode, the PDB requirement for these 5QIs can be relaxed for the first packet(s) in a downlink data or signalling burst in order to permit battery saving (DRX) techniques.  NOTE 11: In RRC\_IDLE and RRC\_INACTIVE mode, the PDB requirement for these 5QIs can be relaxed for the first packet(s) in a downlink data or signalling burst in order to permit battery saving (DRX) techniques.  NOTE 12: This 5QI value can only be assigned upon request from the network side. The UE and any application running on the UE is not allowed to request this 5QI value.  NOTE 13: A static value for the CN PDB of 20 ms for the delay between a UPF terminating N6 and a 5G-AN should be subtracted from a given PDB to derive the packet delay budget that applies to the radio interface.  NOTE 14: This 5QI is only used for transmission of V2X messages as defined in TS 23.287 [121] and transmission of A2X messages as defined in TS 23.256 [136].  NOTE 15: For "live" uplink streaming (see TS 26.238 [76]), guidelines for PDB values of the different 5QIs correspond to the latency configurations defined in TR 26.939 [77]. In order to support higher latency reliable streaming services (above 500ms PDB), if different PDB and PER combinations are needed these configurations will have to use non-standardised 5QIs.  NOTE 16: These services are expected to need much larger MDBV values to be signalled to the RAN. Support for such larger MDBV values with low latency and high reliability is likely to require a suitable RAN configuration, for which, the simulation scenarios in TR 38.824 [112] may contain some guidance.  NOTE 17: The worst case one way propagation delay for GEO satellite is expected to be ~270ms,~21 ms for LEO at 1200km, and 13 ms for LEO at 600km. The UL scheduling delay that needs to be added is also typically two way propagation delay e.g. ~540ms for GEO, ~42ms for LEO at 1200km, and ~26 ms for LEO at 600km. Based on that, the 5G-AN Packet delay budget is not applicable for 5QIs that require 5G-AN PDB lower than the sum of these values when the specific types of satellite access are used (see TS 38.300 [27]). 5QI-10 can accommodate the worst case PDB for GEO satellite type.  NOTE X: When UE is accessing the network via satellite access supporting regenerative payload, a static value for the CN PDB of ~290ms for GEO satellite, ~41 ms for LEO at 1200km, and 33 ms for LEO at 600km for the delay between a UPF terminating N6 and a 5G-AN should be subtracted from a given PDB to derive the packet delay budget that applies to the radio interface. | | | | | | | |

NOTE: It is preferred that a value less than 64 is allocated for any new standardised 5QI of Non-GBR resource type. This is to allow for option 1 to be used as described in clause 5.7.1.3 (as the QFI is limited to less than 64).

## 

\*\*\*\*\* Sixth Change \*\*\*\*\*

## 6.2 Network Function Functional description

### 6.2.1 AMF

The Access and Mobility Management function (AMF) includes the following functionality. Some or all of the AMF functionalities may be supported in a single instance of an AMF:

- Termination of RAN CP interface (N2).

- Termination of NAS (N1), NAS ciphering and integrity protection.

- Registration management.

- Connection management.

- Reachability management.

- Mobility Management.

- Lawful intercept (for AMF events and interface to LI System).

- Provide transport for SM messages between UE and SMF.

- Transparent proxy for routing SM messages.

- Access Authentication.

- Access Authorization.

- Provide transport for SMS messages between UE and SMSF.

- Security Anchor Functionality (SEAF) as specified in TS 33.501 [29].

- Location Services management for regulatory services.

- Provide transport for Location Services messages between UE and LMF as well as between RAN and LMF.

- EPS Bearer ID allocation for interworking with EPS.

- UE mobility event notification.

- S-NSSAIs per TA mapping notification.

- Support for Control Plane CIoT 5GS Optimisation.

- Support for User Plane CIoT 5GS Optimisation.

- Support for restriction of use of Enhanced Coverage.

- Provisioning of external parameters (Expected UE Behaviour parameters or Network Configuration parameters).

- Support for Network Slice-Specific Authentication and Authorization.

- Support for charging.

- Controlling the 5G access stratum-based time distribution based on UE's subscription data.

- Controlling the gNB's time synchronization status reporting and subscription.

NOTE 1: Regardless of the number of Network functions, there is only one NAS interface instance per access network between the UE and the CN, terminated at one of the Network functions that implements at least NAS security and Mobility Management.

In addition to the functionalities of the AMF described above, the AMF may include the following functionality to support non-3GPP access networks:

- Support of N2 interface with N3IWF/TNGF. Over this interface, some information (e.g. 3GPP Cell Identification) and procedures (e.g. Handover related) defined over 3GPP access may not apply, and non-3GPP access specific information may be applied that do not apply to 3GPP accesses.

- Support of NAS signalling with a UE over N3IWF/TNGF. Some procedures supported by NAS signalling over 3GPP access may be not applicable to untrusted non-3GPP (e.g. Paging) access.

- Support of authentication of UEs connected over N3IWF/TNGF.

- Management of mobility, authentication, and separate security context state(s) of a UE connected via a non-3GPP access or connected via a 3GPP access and a non-3GPP access simultaneously.

- Support as described in clause 5.3.2.3 a co-ordinated RM management context valid over a 3GPP access and a Non 3GPP access.

- Support as described in clause 5.3.3.4 dedicated CM management contexts for the UE for connectivity over non-3GPP access.

- Determine whether the serving N3IWF/TNGF is appropriate based on the slices supported by the N3IWFs/TNGFs as specified in clause 6.3.6 and clause 6.3.12 respectively.

NOTE 2: Not all of the functionalities are required to be supported in an instance of a Network Slice.

In addition to the functionalities of the AMF described above, the AMF may include policy related functionalities as described in clause 6.2.8 of TS 23.503 [45].

The AMF uses the N14 interface for AMF re-allocation and AMF to AMF information transfer. This interface may be either intra-PLMN or inter-PLMN (e.g. in the case of inter-PLMN mobility).

In addition to the functionality of the AMF described above, the AMF may include the following functionality to support monitoring in roaming scenarios:

- Normalization of reports according to roaming agreements between VPLMN and HPLMN (e.g. change the location granularity in a report from cell level to a level that is appropriate for the HPLMN); and

- Generation of charging/accounting information for Monitoring Event Reports that are sent to the HPLMN.

In addition to the functionality of the AMF described above, the AMF may provide support for Network Slice restriction and Network Slice instance restriction based on NWDAF analytics.

In addition to the functionalities of the AMF described above, the AMF may provide support for the Disaster Roaming as described in clause 5.40.

In addition to the functionalities of the AMF described above, the AMF may also include following functionalities to support Network Slice Admission Control:

- Support of NSAC for maximum number of UEs as defined in clauses 5.15.11.1 and 5.15.11.3.

In addition to the functionality of the AMF described above, the AMF may include the following functionality to support SNPNs:

- Support for Onboarding of UEs for SNPNs.

In addition to the functionalities of the AMF described above, the AMF may also include following functionalities to support satellite backhaul:

- Support for reporting satellite backhaul category and its modification based on AMF local configuration to SMF as defined in clause 5.43.4.

In addition to the functionalities of the AMF described above, the AMF may also include following functionalities to support regenerative-based satellite access:

- Support for NG Removal procedure defined in TS 38.413 [34].

In addition to the functionalities of the AMF described above, the AMF may provide support for Network Slice instance change for PDU sessions as defined in clause 5.15.5.3.

In addition to the functionalities of the AMF described above, the AMF may also support functionalities for Partial Network Slice support in a Registration Area as described in clause 5.15.17.

In addition to the functionalities of the AMF described above, the AMF may also include functionalities to support NS-AoS not matching deployed Tracking Areas as described in clause 5.15.18.

In addition to the functionalities of the AMF described above, the AMF may also include functionalities to support Network Slice Replacement as described in clause 5.15.19.

In addition to the functionalities of the AMF described above, the AMF may also include functionalities to enforce the LADN Service Area per LADN DNN and S-NSSAI for a UE as described in clause 5.6.5a, as well as to enforce the LADN Service Area per LADN DNN for a UE in clause 5.6.5.

\*\*\*\*\* Seventh Change \*\*\*\*\*

### 6.3.5 AMF discovery and selection

The AMF discovery and selection functionality is applicable to both 3GPP access and non-3GPP access.

The AMF selection functionality can be supported by the 5G-AN (e.g. RAN, N3IWF) and is used to select an AMF instance for a given UE. An AMF supports the AMF selection functionality to select an AMF for relocation or because the initially selected AMF was not an appropriate AMF to serve the UE (e.g. due to change of Allowed NSSAI). Other CP NF(s), e.g. SMF, supports the AMF selection functionality to select an AMF from the AMF set when the original AMF serving a UE is unavailable.

The TSCTSF shall use the AMF discovery functionality to determine the AMFs serving the TAs in the spatial validity condition provided by the AF.

5G-AN selects an AMF Set and an AMF from the AMF Set under the following circumstances:

1) When the UE provides no 5G-S-TMSI nor the GUAMI to the 5G-AN.

2) When the UE provides 5G-S-TMSI or GUAMI but the routing information (i.e. AMF identified based on AMF Set ID, AMF pointer) present in the 5G-S-TMSI or GUAMI is not sufficient and/or not usable (e.g. UE provides GUAMI with an AMF region ID from a different region).

NOTE 1: When the UE accesses 5G-AN onboard satellite (i.e. regenerative based satellite access), the 5G-AN can be configured to enforce selection of dedicated AMF set(s) supporting regenerative-based satellite access.

3) AMF has instructed AN that the AMF (identified by GUAMI(s)) is unavailable and no target AMF is identified and/or AN has detected that the AMF has failed.

4) When the UE attempts to establish a signalling connection, and the following conditions are met:

- the 5G-AN knows in what country the UE is located; and

- the 5G-AN is connected to AMFs serving different PLMNs of different countries; and

- the UE provides a 5G-S-TMSI or GUAMI, which indicates an AMF serving a different country to where the UE is currently located; and

- the 5G-AN is configured to enforce selection of the AMF based on the country the UE is currently located.

Then the 5G-AN shall select an AMF serving a PLMN corresponding to the UE's current location. How 5G-AN selects the AMF in this case is defined in TS 38.410 [125].

NOTE 2: AMF selection case 4) does not apply if 5G-AN nodes serves one country only.

In the case of NF Service Consumer based discovery and selection, the CP NF selects an AMF from the AMF Set under the following circumstances:

- When the AMF has instructed CP NF that a certain AMF identified by GUAMI(s) is unavailable and the CP NF was not notified of target AMF; and/or

- CP NF has detected that the AMF has failed; and/or

- When the selected AMF does not support the UE's Preferred Network Behaviour; and/or

- When the selected AMF does not support the High Latency communication for NR RedCap UE.

In the case of delegated discovery and associated selection, the SCP selects an AMF from the corresponding AMF Set under the following circumstances:

- The SCP gets an indication "select new AMF within SET" from the CP NF; and/or

- SCP has detected that the AMF has failed.

The AMF selection functionality in the 5G-AN may consider the following factors for selecting the AMF Set:

- AMF Region ID and AMF Set ID derived from GUAMI;

- Requested NSSAI;

- Local operator policies;

- 5G CIoT features indicated in RRC signalling by the UE;

- IAB-indication;

- NB-IoT RAT Type;

- Category M Indication;

- NR RedCap Indication;

- SNPN Onboarding indication as indicated in 5G-AN signalling by the UE;

- Mobile IAB-indication.

AMF selection functionality in the 5G-AN or CP NFs or SCP considers the following factors for selecting an AMF from AMF Set:

- Availability of candidate AMF(s).

- Load balancing across candidate AMF(s) (e.g. considering weight factors of candidate AMFs in the AMF Set).

- In 5G-AN, 5G CIoT features indicated in RRC signalling by the UE.

- In 5G-AN, SNPN Onboarding indication as indicated in 5G-AN signalling by the UE.

When the UE accesses the 5G-AN with a 5G-S-TMSI or GUAMI that identifies more than one AMF (as configured during N2 setup procedure), the 5G-AN selects the AMF considering the weight factors.

When 5G-S-TMSI or GUAMI provided by the UE to the 5G-AN contains an AMF Set ID that is usable, and the AMF identified by AMF pointer that is not usable (e.g. AN detects that the AMF has failed) or the corresponding AMF indicates it is unavailable (e.g. out of operation) then the 5G-AN uses the AMF Set ID for selecting another AMF from the AMF set considering the factors above.

The discovery and selection of AMF in the CP NFs or SCP follows the principle in clause 6.3.1

In the case of NF Service Consumer based discovery and selection, the AMF or other CP NFs shall utilize the NRF to discover the AMF instance(s) unless AMF information is available by other means, e.g. locally configured on AMF or other CP NFs. The NRF provides the NF profile(s) of AMF instance(s) to the AMF or other CP NFs. The AMF selection function in the AMF or other CP NFs selects an AMF instance as described below:

When NF Service Consumer performs discovery and selection the following applies:

- In the case of AMF discovery and selection functionality in AMF or other CP NFs use GUAMI (in the SNPN case, along with NID of the SNPN that owns the AMF instances to be discovered and selected) or TAI to discover the AMF instance(s), the NRF provides the NF profile of the associated AMF instance(s). If an associated AMF is unavailable due to AMF planned removal, the NF profile of the backup AMF used for planned removal is provided by the NRF. If an associated AMF is unavailable due to AMF failure, the NF profile of the backup AMF used for failure is provided by the NRF. If AMF pointer value in the GUAMI is associated with more than one AMF, the NRF provides all the AMFs associated with this AMF pointer value. If no AMF instances related to the indicated GUAMI can be found, the NRF may provide a list of NF profiles of candidate AMF instances in the same AMF Set. The other CP NF or AMF may select any AMF instance from the list of candidate AMF instances. If no NF profiles of AMF is returned in the discovery result, the other CP NF or AMF may discover an AMF using the AMF Set as below.

- In the case of AMF discovery and selection functionality in AMF use AMF Set to discover AMF instance(s), the NRF provides a list of NF profiles of AMF instances in the same AMF Set.

- At intra-PLMN mobility, the AMF discovery and selection functionality in AMF may use AMF Set ID, AMF Region ID, the target location information, S-NSSAI(s) of Allowed NSSAI to discover target AMF instance(s). The NRF provides the target NF profiles matching the discovery.

- At intra-SNPN mobility, the AMF discovery and selection functionality in AMF may use AMF Set ID, AMF Region ID (along with NID of the SNPN that owns the AMF instances to be discovered and selected), the target location information, S-NSSAI(s) of Allowed NSSAI, AMF support of SNPN Onboarding (if the UE is registered for SNPN Onboarding) to discover target AMF instance(s). The NRF provides the target NF profiles matching the discovery.

- At inter PLMN mobility, the source AMF selects an AMF instance(s) in the target PLMN by querying target PLMN level NRF via the source PLMN level NRF with target PLMN ID. The target PLMN level NRF returns an AMF instance address based on the target operator configuration. After the Handover procedure the AMF may select a different AMF instance as specified in clause 4.2.2.2.3 of TS 23.502 [3].

In the context of Network Slicing, the AMF selection is described in clause 5.15.5.2.1.

When delegated discovery and associated selection is used, the following applies:

- If the CP NF includes GUAMI or TAI in the request, the SCP selects an AMF instance associated with the GUAMI or TAI and sends the request to a selected AMF service instance if it is available. The following also applies:

- If none of the associated AMF service instances are available due to AMF planned removal, an AMF service instance from the backup AMF used for planned removal is selected by the SCP;

- If none of the associated AMF service instances are available due to AMF failure, an AMF service instance from the backup AMF used for failure is selected by the SCP;

- If no AMF service instances related to the indicated GUAMI (in the SNPN case, along with NID of the SNPN that owns the AMF instances to be discovered and selected) can be found the SCP selects an AMF instance from the AMF Set; or

- AMF Pointer value used by more than one AMF, SCP selects one of the AMF instances associated with the AMF Pointer.

- If the CP NF includes AMF Set ID in the request, the SCP selects AMF/AMF service instances in the provided AMF Set.

- At intra-PLMN mobility, if a target AMF instance needs to be selected, the AMF may provide AMF Set ID, AMF Region ID, and the target location information, S-NSSAI(s) of Allowed NSSAI in the request, optionally NRF to use. The SCP will select a target AMF instance matching the discovery.

- At intra-SNPN mobility, if a target AMF instance needs to be selected, the AMF may provide AMF Set ID, AMF Region ID along with NID of the SNPN that owns the AMF instances to be discovered and selected, and the target location information, S-NSSAI(s) of Allowed NSSAI, AMF support of SNPN Onboarding in the request (if the UE is registered for SNPN Onboarding), optionally NRF to use. The SCP will select a target AMF instance matching the discovery.

- At inter PLMN mobility, the source AMF selects indicates "roaming" to the SCP. The SCP interacts with the NRF in source PLMN so that the NRF in source PLMN can discover an AMF in the target PLMN via target PLMN NRF.

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