**3GPP TSG-WG SA2 Meeting #164 *S2-2408876***

**19 - 23 August, 2024, Maastricht, Netherlands**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **23.501** | **CR** | **5443** | **rev** | **-** | **Current version:** | **19.0.0** |  |
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| *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:***  | AF request and functionalities enhancement to support N6 delay measurement |
|  |  |
| ***Source to WG:*** | China Mobile, ZTE Intel?, Huawei?, CATT?, Samsung?, Nokia?,  |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | eEDGE\_5GC\_ph3 |  | ***Date:*** | 2024-08-09 |
|  |  |  |  |  |
| ***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 canbe 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)* |
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| ***Reason for change:*** | According to the KI#2 conclusion of TR 23.700-49, N6 delay measurement shall be supported by 5GS, and SMF may select local UPF PSA and EAS considering N6 delay. Such feature has impact on the following aspects:1) New feature should be specified on user plane functional description. User plane may perform N6 delay measurement instructed by SMF.2) Support for edge computing. N6 delay may be considered for local PSA UPF and EAS selection, and N6 delay measurement procedure is introduced.3) Functionalities of SMF and UPF. New functionalities need to be illustrated to support N6 delay measurement.4) UPF selection. SMF may select local PSA UPF considering N6 delay. |
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| ***Summary of change:*** | 1. New feature on user plane functional description.2. Update on supporting of edge computing.3. Update on SMF and UPF functionalities.4. Update on UPF selection.The following docs has been merged into this revision: S2-2407659, S2-2407909, S2-2407822, S2-2408387, S2-2408568. |
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| ***Consequences if not approved:*** | N6 delay measurement and enhancement of UPF and EAS selection will not be specified. |
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| ***Clauses affected:*** | 5.8.2.x (new), 5.13, 6.2.2, 6.2.3, 6.3.3.3 |
|  |  |
|  | **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:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\* \* \* \* First change \* \* \* \*

#### 5.8.2.X N6 Delay Measurement and Reporting

The PSA UPF may be configured by the SMF to measure the N6 delay (e.g., UL/DL/RT) between the PSA UPF and endpoint at application side (e.g., EAS IP address(es)/Designated IP (range)).

AF provides the information to support N6 delay measurement via EAS Deployment Information Management as described in clause 6.X.X.X in TS 23.548 [5]. SMF retrieve the EDI information to configure the PSA UPF to support the N6 delay measurement.

AF triggers the dynamic N6 delay measurement with providing indication of N6 delay measurement and involved DNAI(s) and EAS IP address(es) as descrbied in clause 6.3.1 in TS 23.503[xx]. After SMF get the PCC rules from PCF , the SMF configure the UPF to implement the N6 delay measurement between the UPF and EAS(es).The PSA UPF leverages the measurement protocols (e.g., ICMP, TWAMP, OWAMP) to measure the N6 delay and report the N6 delay to the SMF.

Editor’s NOTE: The UPF reports the N6 delay measurement through N4 or SBI is FFS.

The SMF selects PSA UPF(s) and EAS(es) considering N6 delay measurement results.

\* \* \* \* Second change \* \* \* \*

## 5.13 Support for Edge Computing

Edge computing enables operator and 3rd party services to be hosted close to the UE's access point of attachment, so as to achieve an efficient service delivery through the reduced end-to-end latency and load on the transport network. Edge Computing support by 5GC is specified in this specification and in TS 23.548 [130].

NOTE: Edge Computing typically applies to non-roaming and LBO roaming scenarios. For HR roaming scenarios, Edge Computing applies only for "Home Routed with Session Breakout in VPLMN (HR-SBO)" which is described in clause 6.7 of TS 23.548 [130].

The 5G Core Network selects a UPF close to the UE and forwards traffic to enable the local access to the DN via a N6 interface according to the provided traffic steering rules to the UPF. This may be based on the UE's subscription data, UE location, the information from Application Function (AF) as defined in clause 5.6.7, the EAS information reported from EASDF (as defined in TS 23.548 [130]), policy, N6 delay measurement result or other related traffic rules.

Due to user or Application Function mobility, the service or session continuity may be required based on the requirements of the service or the 5G network.

The 5G Core Network may expose network information and capabilities to an Edge Computing Application Function.

NOTE: Depending on the operator deployment, certain Application Functions can be allowed to interact directly with the Control Plane Network Functions with which they need to interact, while the other Application Functions need to use the external exposure framework via the NEF (see clause 6.2.10 for details).

Edge computing can be supported by one or a combination of the following enablers:

- User plane (re)selection: the 5G Core Network (re)selects UPF to route the user traffic to the local part of the DN as described in clause 6.3.3;

- Local Routing and Traffic Steering: the 5G Core Network selects the traffic to be routed to the applications in the local part of the DN;

- this includes the use of a single PDU Session with multiple PDU Session Anchor(s) (UL CL / IP v6 multi-homing) as described in clause 5.6.4 and the use of a PDU Session with Distributed Anchor Point using SSC mode 2/3.

- Session and service continuity to enable UE and application mobility as described in clause 5.6.9;

- An Application Function may influence UPF (re)selection and traffic routing via PCF or NEF as described in clause 5.6.7;

- Network capability exposure: 5G Core Network and Application Function to provide information to each other via NEF as described in clause 5.20 or directly as described in clause 4.15 of TS 23.502 [3] or from the UPF as described in clause 6.4 of TS 23.548 [130];

- QoS and Charging: PCF provides rules for QoS Control and Charging for the traffic routed to the local part of the DN;

- Support of Local Area Data Network: 5G Core Network provides support to connect to the LADN in a certain area where the applications are deployed as described in clause 5.6.5.

- Discovery and re-discovery of Edge Applications Servers as described in TS 23.548 [130].

- Support of Edge Relocation as described in TS 23.548 [130] and the case of involving AF change as described in clauses 4.3.6.2, 4.3.6.3 and 4.3.6.4 of TS 23.502 [3]. Support of 5GC triggered Edge relocation within the same hosting PLMN's EHEs.

- Support of (I-)SMF (re)selection based on DNAI as described in clauses 4.3.5.1, 4.3.5.2 and 4.23.5.1 of TS 23.502 [3].

- Support of finer sets of UEs.

- Support of common EAS discovery and common DNAI determination for set of UEs as described in clause 6.2 of TS 23.548 [130].

- Support of mapping information between EAS IP/IP range and DNAI as described in clause 6.8 of TS 23.548 [130].

- Support of AF request for DNAI as described in clause 6.8 of TS 23.548 [130].

- Support of N6 delay measurement as described in clause 4.3.x of TS 23.502 [3] and clause 6.2.3.2.x of TS 23.548 [130].

\* \* \* \* Third change \* \* \* \*

### 6.2.2 SMF

The Session Management function (SMF) includes the following functionality. Some or all of the SMF functionalities may be supported in a single instance of a SMF:

- Session Management e.g. Session Establishment, modify and release, including tunnel maintain between UPF and AN node.

- UE IP address allocation & management (including optional Authorization). The UE IP address may be received from a UPF or from an external data network.

- DHCPv4 (server and client) and DHCPv6 (server and client) functions.

- Functionality to respond to Address Resolution Protocol (ARP) requests and / or IPv6 Neighbour Solicitation requests based on local cache information for the Ethernet PDUs. The SMF responds to the ARP and / or the IPv6 Neighbour Solicitation Request by providing the MAC address corresponding to the IP address sent in the request.

- Selection and control of UP function, including controlling the UPF to proxy ARP or IPv6 Neighbour Discovery, or to forward all ARP/IPv6 Neighbour Solicitation traffic to the SMF, for Ethernet PDU Sessions.

- Configures traffic steering at UPF to route traffic to proper destination.

- 5G VN group management, e.g. maintain the topology of the involved PSA UPFs, establish and release the N19 tunnels between PSA UPFs, configure traffic forwarding at UPF to apply local switching, N6-based forwarding or N19-based forwarding, manage traffic forwarding in the case that a SMF Set or multiple SMF Sets are serving a 5G VN.

- Termination of interfaces towards Policy control functions.

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

- Support for charging.

- Control and coordination of charging data collection at UPF.

- Termination of SM parts of NAS messages.

- Downlink Data Notification.

- Initiator of AN specific SM information, sent via AMF over N2 to AN.

- Determine SSC mode of a session.

- Support for Control Plane CIoT 5GS Optimisation.

- Support of header compression.

- Act as I-SMF in deployments where I-SMF can be inserted, removed and relocated.

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

- Support P-CSCF discovery for IMS services.

- Act as V-SMF with following roaming functionalities:

- Handle local enforcement to apply QoS SLAs (VPLMN).

- Charging (VPLMN).

- Lawful intercept (in VPLMN for SM events and interface to LI System).

- Support for interaction with external DN for transport of signalling for PDU Session authentication/authorization by external DN.

- Instructs UPF and NG-RAN to perform redundant transmission on N3/N9 interfaces.

- Generation of the TSC Assistance Information based on the TSC Assistance Container received from the PCF.

- Support for RAN feedback for BAT offset and adjusted periodicity as defined in clause 5.27.2.5.

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

In addition to the functionalities of the SMF described above, the SMF may include policy related functionalities as described in clause 6.2.2 of TS 23.503 [45].

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

- Normalization of reports according to roaming agreements between VPLMN and HPLMN; and

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

The SMF may also include following functionalities to support Edge Computing enhancements (further defined in TS 23.548 [130]):

- Selection of EASDF, obtain and/or provision DNS security information of the EASDF and provision of its address to the UE as the DNS Server for the PDU session;

- Usage of EASDF services as defined in TS 23.548 [130];

- For supporting the Application Layer Architecture defined in TS 23.558 [134]: Provision and updates of ECS Address Configuration Information to the UE;

- For supporting the HR-SBO as defined in clause 6.7 of TS 23.548 [130].

- For supporting the N6 delay measurement as described in 6.xxx of TS23.548[130].

- For supporting the selection of local PSA UPF and EAS(es) with considering N6 delay values.

The SMF and SMF+ PGW-C may also include following functionalities to support Network Slice Admission Control:

- Support of NSAC for maximum number of PDU sessions as defined in clauses 5.15.11.2, 5.15.11.3 and 5.15.11.5.

- Support of NSAC for maximum number of UEs as defined in clauses 5.15.11.3 and 5.15.11.5.

The SMF may also include following functionalities:

- Providing per-QoS flow Non-3GPP QoS assistance information to the UE (e.g. PEGC) and formulation of the CN PDB based on non-3GPP delay budget from UE (e.g. PEGC) as described in clause 5.44.3.4.

- Support of PDU Set based handling as described in clause 5.37.5.

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

The SMF may also include functionalities to support indirect UPF event exposure service subscription on behalf of the consumer NF(s) as described in clause 4.15.4.5 of TS 23.502 [3].

\* \* \* \* Fourth change \* \* \* \*

### 6.2.3 UPF

The User plane function (UPF) includes the following functionality. Some or all of the UPF functionalities may be supported in a single instance of a UPF:

- Anchor point for Intra-/Inter-RAT mobility (when applicable).

- Allocation of UE IP address/prefix (if supported) in response to SMF request.

- External PDU Session point of interconnect to Data Network.

- Packet routing & forwarding (e.g. support of Uplink classifier to route traffic flows to an instance of a data network, support of Branching point to support multi-homed PDU Session, support of traffic forwarding within a 5G VN group (UPF local switching, via N6, via N19)).

- Packet inspection (e.g. Application detection based on service data flow template and the optional PFDs received from the SMF in addition).

- User Plane part of policy rule enforcement, e.g. Gating, Redirection, Traffic steering).

- Lawful intercept (UP collection).

- Traffic usage reporting.

- QoS handling for user plane, e.g. UL/DL rate enforcement, Reflective QoS marking in DL.

- Uplink Traffic verification (SDF to QoS Flow mapping).

- Transport level packet marking in the uplink and downlink.

- Downlink packet buffering and downlink data notification triggering.

- Sending and forwarding of one or more "end marker" to the source NG-RAN node.

- Functionality to respond to Address Resolution Protocol (ARP) requests and / or IPv6 Neighbour Solicitation requests based on local cache information for the Ethernet PDUs. The UPF responds to the ARP and / or the IPv6 Neighbour Solicitation Request by providing the MAC address corresponding to the IP address sent in the request.

- Packet duplication in downlink direction and elimination in uplink direction in GTP-U layer.

- NW-TT functionality.

- High latency communication, see clause 5.31.8.

- ATSSS Steering functionality to steer the MA PDU Session traffic, refer to clause 5.32.6.

NOTE: Not all of the UPF functionalities are required to be supported in an instance of user plane function of a Network Slice.

- Inter PLMN UP Security (IPUPS) functionality, specified in clause 5.8.2.14.

- Event exposure, including exposure of network information, i.e. the QoS monitoring information, as specified in clause 5.8.2.18, events as specified in clause 5.2.26.2 of TS 23.502 [3], exposure of data collected for analytics, as specified in clause 5.2.26.2 of TS 23.502 [3] and exposure of the TSC management information as specified in clause 5.8.5.14.

- Exposure of the UE information, e.g. UE IP address translation information as specified in clause 5.2.26.3 of TS 23.502 [3] and clause 4.15.10 of TS 23.502 [3] if Network address translation (i.e. NAT) functionality of the UE IP address is deployed within UPF.

- Support PDU Set Handling as defined in clause 5.37.5.

- Support N6 delay measurement and reporting to SMF, as defined in clause 5.8.2.X.

\* \* \* \* Fifth change \* \* \* \*

#### 6.3.3.3 Selection of an UPF for a particular PDU Session

The following parameter(s) and information may be considered by the SMF for UPF selection and re-selection:

- UPF's dynamic load.

- Analytics (i.e. statistics or predictions) for UPF load, Service Experience analytics and/or DN Performance analytics per UP path (including UPF and/or DNAI and/or AS instance) and UE related analytics (UE mobility, UE communication, and expected UE behavioural parameters) as received from NWDAF (see TS 23.288 [86]), if NWDAF is deployed.

- UPF's relative static capacity among UPFs supporting the same DNN.

- UPF location available at the SMF.

- UE location information.

- Capability of the UPF and the functionality required for the particular UE session: An appropriate UPF can be selected by matching the functionality and features required for an UE.

- Data Network Name (DNN).

- PDU Session Type (i.e. IPv4, IPv6, IPv4v6, Ethernet Type or Unstructured Type) and if applicable, the static IP address/prefix.

- SSC mode selected for the PDU Session.

- UE subscription profile in UDM.

- DNAI as included in the PCC Rules and described in clause 5.6.7.

- Local operator policies.

- S-NSSAI.

- Access technology being used by the UE.

- Information related to user plane topology and user plane terminations, that may be deduced from:

- 5G-AN-provided identities (e.g. CellID, TAI), available UPF(s) and DNAI(s);

- Identifiers (i.e. a FQDN and/or IP address(es)) of N3 terminations provided by a W-AGF or a TNGF or a TWIF;

NOTE 1: A W-AGF or a TNGF may provide Identifiers of its N3 terminations when forwarding over N2 uplink NAS signalling to the 5GC. The AMF may relay this information to the SMF, as part of session management signalling for a new PDU Session.

- Information regarding the user plane interfaces of UPF(s). This information may be acquired by the SMF using N4;

- Information regarding the N3 User Plane termination(s) of the AN serving the UE. This may be deduced from 5G-AN-provided identities (e.g. CellID, TAI);

- Information regarding the N9 User Plane termination(s) of UPF(s) if needed;

- Information regarding the User plane termination(s) corresponding to DNAI(s).

- RSN, support for redundant GTP-U path or support for redundant transport path in the transport layer (as in clause 5.33.2) when redundant UP handling is applicable.

- Information regarding the ATSSS Steering Capability of the UE session (e.g. any combination of ATSSS-LL capability, MPTCP capability, MPQUIC capability) and information on the UPF support of RTT measurements without PMF.

- Support for UPF allocation of IP address/prefix.

- Support of the IPUPS functionality, specified in clause 5.8.2.14.

- Support for High latency communication (see clause 5.31.8).

- Support for functionality associated with high data rate low latency services, eXtended Reality (XR) and interactive media services, specified in clause 5.37 (for example, ECN marking for L4S, specified in clause 5.37.3, PDU Set Marking, specified in clause 5.37.5, UE power saving management, specified in clause 5.37.8).

- User Plane Latency Requirements within AF request (see clause 5.6.7.1 and clause 6.3.6 of TS 23.548 [130]).

- List of supported Event ID(s) for exposure of UPF-related information via service based interface (see clause 7.2.29 and clause 5.2.26.2 of TS 23.502 [3]).

- N6 delay between the local PSA UPF and endpoint at the application side (e.g. EAS), specified in 5.8.2.X.

NOTE 2: How the SMF determines information about the user plane network topology from information listed above, and what information is considered by the SMF, is based on operator configuration.

NOTE 3: In this release the SMF uses no additional parameters for UPF selection for a PDU Session serving TSC or Deterministic Networking. If a PDU Session needs to connect to a specific UPF hosting a specific TSN 5GS bridge or 5GS router, this can be achieved e.g. by using a dedicated DNN/S-NSSAI combination.

If there is an existing PDU Session, and the SMF receives another PDU Session request to the same DNN and S-NSSAI, and if the SMF determines that interworking with EPC is supported for this PDU Session (as specified in clause 4.11.5 of TS 23.502 [3]), the SMF should select the same UPF if it supports all capabilities required for the new PDU Session. Otherwise, if the SMF determines that interworking with EPC is not supported for the new PDU Session or the UPF of the existing PDU Session does not support all capabilities required for the new PDU Session, a different UPF may be selected according to operator policy.

For the same DNN and S-NSSAI if different UPFs are selected at 5GC, when the UE is moved to EPC network, there is no requirement to enforce APN-AMBR. Whether and how to apply APN-AMBR for the PDN Connection associated with this DNN/APN is implementation dependent, e.g. possibly only AMBR enforcement per PDU Session applies.

\* \* \* \* End of changes \* \* \* \*