**3GPP TSG-WG SA2 Meeting #164 *S2-2407688r3***

**19 - 23 August, 2024, Maastricht, Netherlands (revised from S2-2407688r1, S2-2407688r2)**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **23.501** | **CR** | **5441** | **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:*** | Support of UPF selection according to the conclusion in FS\_UPEAS\_Ph2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | SK Telecom, Vodafone, Deutsche Telekom, China Mobile, Rakuten, Samsung, Nokia, Huawei, Ericsson? | | | | | | | | | |
| ***Source to TSG:*** | SA2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | UPEAS\_Ph2 | | | | |  | ***Date:*** | | | 2024-08-19 |
|  |  | | | |  | |  | | |  |
| ***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:*** | | As concluded in clause 8.1 of TR 23.700-63:  - The following UPF functionalities are added in the N4 capabilities and UPF NF profile stored in NRF:  - The functionality of NAT information exposure.  - Packet Inspection functionality (to differentiate between IP or MAC filter based packet detection, and the packet detection based on other means, e.g. layer 7 DPI).  - Defining operator configurable parameter in the N4 capabilities and UPF NF profile which can be used for non-standard or partially supported features and configured by operator to extend the baseline UPF capabilities. The format of the parameter is to be determined by stage 3.  - for example, the operator may configure values for this parameter to represent customized configuration (e.g. hardware accelerators (for example GPU, DPU etc.), Firewall, DDos Protection, etc.).  - The SMF may determine the PSA UPF functionalities for PDU Session based on:  - Subscription information from the UDM/UDR: The SMF may receive subscription information from the UDM, during (or after) the establishment of the PDU session, indicating functionalities that are required and/or preferred for the PDU session.  Based on the above conclusions for KI#1, the enhancements on UPF selection are proposed:  - operator configurable parameters | | | | | | | | |
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| ***Summary of change:*** | | Support of UPF selection by providing a selected user plane functionality (operator configurable parameter) | | | | | | | | |
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| ***Consequences if not approved:*** | | This new defined capability of UPF selection in UPEAS\_Ph2 will not be supported. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.8.5.1, 6.2.6.2, 6.3.3.3, 5.8.2.X (all new text), 6.2.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 23.502 CR 4863 | | |
| ***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 \* \* \* \*

#### 5.8.5.1 General

These parameters are used by SMF to control the functionality of the UPF as well as to inform SMF about events occurring at the UPF.

The N4 session management procedures defined in clause 4.4.1 of TS 23.502 [3] will use the relevant parameters in the same way for all N4 reference points: the N4 Session Establishment procedure as well as the N4 Session Modification procedure provide the control parameters to the UPF, the N4 Session Release procedure removes all control parameters related to an N4 session, and the N4 Session Level Reporting procedure informs the SMF about events related to the PDU Session that are detected by the UPF.

The parameters over N4 reference point provided from SMF to UPF comprises an N4 Session ID and may also contain:

- Packet Detection Rules (PDR) that contain information to classify traffic (PDU(s)) arriving at the UPF;

- Forwarding Action Rules (FAR) that contain information on whether forwarding, dropping or buffering is to be applied to a traffic identified by PDR(s);

- Multi-Access Rules (MAR) that contain information on how to handle traffic steering, switching and splitting for a MA PDU Session;

- Usage Reporting Rules (URR) contains information that defines how traffic identified by PDR(s) shall be accounted as well as how a certain measurement shall be reported;

- QoS Enforcement Rules (QER), that contain information related to QoS enforcement of traffic identified by PDR(s);

- Session Reporting Rules (SRR) that contain information to request the UP function to detect and report events for a PDU session that are not related to specific PDRs of the PDU session or that are not related to traffic usage measurement.

- Trace Requirements;

- Port Management Information Container in 5GS;

- Bridge/Router Information.

The N4 Session ID is assigned by the SMF and uniquely identifies an N4 session.

If the UPF indicated support of Trace, the SMF may activate a trace session during a N4 Session Establishment or a N4 Session Modification procedure. In that case it provides Trace Requirements to the UPF. The SMF may deactivate an on-going trace session using a N4 Session Modification procedure. There shall be at most one trace session activated per N4 Session at a time.

If the UPF supports operator configurable UPF capability, the SMF will be made aware of this during N4 association setup procedure.

For the MA PDU Session, the SMF may add an additional access tunnel information during an N4 Session Modification procedure by updating MAR with addition of an FAR ID which refers to an FAR containing the additional access tunnel information for the MA PDU session for traffic steering in the UPF. For the MA PDU Session, the SMF may request Access Availability report per N4 Session, during N4 Session Establishment procedure or N4 Session Modification procedure.

A N4 Session may be used to control both UPF and NW-TT behaviour in the UPF. A N4 session support and enable exchange of bridge/router configuration between the SMF and the UPF:

- Information that the SMF needs for bridge/router management (clause 5.8.5.9);

- Information that 5GS transparently relays between the TSN AF or TSCTSF and the NW-TT: transparent Port Management Information Container along with the associated NW-TT port number.

- Information that 5GS transparently relays between the TSN AF or TSCTSF and the NW-TT: transparent user plane node Management Information Container (clause 5.8.5.14).

When a N4 Session related with bridge/router management is established, the UPF allocates a dedicated port number for the PDU Session. The UPF then provides to the SMF following configuration parameters for the N4 Session:

- port number.

- user-plane node ID.

To support TSN, the user-plane node ID is Bridge ID. To support integration with IETF DetNet, the user-plane node ID can be Router ID. The User Plane Node ID may be pre-configured in the UPF based on deployment.

After the N4 session has been established, the SMF and UPF may at any time exchange transparent user plane node and Port Management Information Container over a N4 session.

\* \* \* \* Next change \* \* \* \*

6.2.6.2 NF profile

NF profile of NF instance maintained in an NRF includes the following information:

- NF instance ID.

- NF type.

- PLMN ID in the case of PLMN, PLMN ID + NID in the case of SNPN.

- Network Slice related Identifier(s) e.g. S-NSSAI, NSI ID.

- FQDN or IP address of NF.

- NF capacity information.

- NF priority information.

NOTE 1: This parameter is used for AMF selection, if applicable, as specified in clause 6.3.5. See clause 6.1.6.2.2 of TS 29.510 [58] for its detailed use.

- NF Set ID.

- NF Service Set ID of the NF service instance.

- NF Specific Service authorization information.

- if applicable, Names of supported services.

- Endpoint Address(es) of instance(s) of each supported service.

- Identification of stored data/information.

NOTE 2: This is only applicable for a UDR profile. See applicable input parameters for Nnrf\_NFManagement\_NFRegister service operation in clause 5.2.7.2.2 of TS 23.502 [3]. This information applicability to other NF profiles is implementation specific.

- Other service parameter, e.g. DNN or DNN list, notification endpoint for each type of notification that the NF service is interested in receiving.

- Location information for the NF instance.

NOTE 3: This information is operator specific. Examples of such information can be geographical location, data centre.

- TAI(s).

- NF load information.

- Routing Indicator, Home Network Public Key identifier, for UDM and AUSF.

- For UDM, AUSF and NSSAAF in the case of access to an SNPN using credentials owned by a Credentials Holder with AAA Server, identification of Credentials Holder (i.e. the realm of the Network Specific Identifier based SUPI).

- For UDM and AUSF, and if UDM/AUSF is used for access to an SNPN using credentials owned by a Credentials Holder, identification of Credentials Holder (i.e. the realm if Network Specific Identifier based SUPI is used or the MCC and MNC if IMSI based SUPI is used); see clause 5.30.2.1.

- For AUSF and NSSAAF in the case of SNPN Onboarding using a DCS with AAA server, identification of DCS (i.e. the realm of the Network Specific Identifier based SUPI).

- For UDM and AUSF, and if UDM/AUSF is used as DCS in the case of SNPN Onboarding, identification of DCS (i.e. the realm if Network Specific Identifier based SUPI, or the MCC and MNC if IMSI based SUPI).

- One or more GUAMI(s), in the case of AMF.

- For the UPF, see clause 5.2.7.2.2 of TS 23.502 [3].

- UDM Group ID, range(s) of SUPIs, range(s) of GPSIs, range(s) of internal group identifiers, range(s) of external group identifiers for UDM.

- UDR Group ID, range(s) of SUPIs, range(s) of GPSIs, range(s) of external group identifiers for UDR.

- AUSF Group ID, range(s) of SUPIs for AUSF.

- PCF Group ID, range(s) of SUPIs for PCF.

- HSS Group ID, set(s) of IMPIs, set(s) of IMPU, set(s) of IMSIs, set(s) of PSIs, set(s) of MSISDN for HSS.

- For NWDAF, the following information are supported:

- Analytics ID(s) (possibly per service).

- NWDAF Serving Area information (i.e. list of TAIs for which the NWDAF can provide services and/or data).

- Supported Analytics Delay per Analytics ID (if available).

- NF types of the NF data sources, NF Set IDs of the NF data sources, if available.

- Analytics aggregation capability (if available).

- Analytics metadata provisioning capability (if available).

- ML model Filter information parameters include S-NSSAI(s) and Area(s) of Interest for the trained ML model(s) per Analytics ID(s).

- ML Model Interoperability indicator (if available) per Analytics ID(s).

- FL capability information per analytics ID including FL capability type (i.e. FL server and/or FL client, if available).

- Time interval supporting FL (if available).

- Accuracy checking capability for ML model accuracy monitoring or Analytics Accuracy Monitoring (if available).

- Roaming exchange capability (if available).

NOTE 4: The NWDAF's Serving Area information is common to all its supported Analytics IDs.

NOTE 5: The Analytics IDs supported by the NWDAF may be associated with a Supported Analytics Delay i.e. the Analytics report can be generated with a time (including data collection delay and inference delay) in less than or equal to the Supported Analytics Delay.

NOTE 6: The determination of Supported Analytics Delay, and how the NWDAF avoid updating its Supported Analytics Delay in NRF frequently is NWDAF implementation specific.

- Event ID(s) supported by AFs, in the case of NEF.

- Event Exposure service supported event ID(s) by UPF.

- Application Identifier(s) supported by AFs, in the case of NEF.

- Range(s) of External Identifiers, or range(s) of External Group Identifiers, or the domain names served by the NEF, in the case of NEF.

NOTE 7: This is applicable when NEF exposes AF information for analytics purpose as detailed in TS 23.288 [86].

NOTE 8: It is expected service authorization information is usually provided by OA&M system, and it can also be included in the NF profile in the case that e.g. an NF instance has an exceptional service authorization information.

NOTE 9: The NRF may store a mapping between UDM Group ID and SUPI(s), UDR Group ID and SUPI(s), AUSF Group ID and SUPI(s) and PCF Group ID and SUPI(s), to enable discovery of UDM, UDR, AUSF and PCF using SUPI, SUPI ranges as specified in clause 6.3 or interact with UDR to resolve the UDM Group ID/UDR Group ID/AUSF Group ID/PCF Group ID based on UE identity, e.g. SUPI (see clause 6.3.1 for details).

- IP domain list as described in clause 6.1.6.2.21 of TS 29.510 [58], Range(s) of (UE) IPv4 addresses or Range(s) of (UE) IPv6 prefixes, Range(s) of SUPIs or Range(s) of GPSIs or a BSF Group ID, in the case of BSF.

- SCP Domain the NF belongs to.

- DCCF Serving Area information, NF types of the data sources, NF Set IDs of the data sources, if available, in the case of DCCF.

- Supported DNAI list, in the case of SMF.

- For SNPN, capability to support SNPN Onboarding in the case of AMF and capability to support User Plane Remote Provisioning in the case of SMF.

- IP address range, DNAI for UPF.

- Operator configurable UPF capability for UPF features(s) as described in clause 5.8.2.X.

- Supported DNS security protocols, in the case of EASDF.

- Additional V2X related NF profile parameters are defined in TS 23.287 [121].

- Additional ProSe related NF profile parameters are defined in TS 23.304 [128].

- Additional MBS related NF profile parameters are defined in TS 23.247 [129].

- Additional UAS related NF profile parameters are defined in TS 23.256 [136].

- Additional Ranging based services and Sidelink Positioning related NF profile parameters are defined in TS 23.586 [180].

- For additional information in PCF profile, see clause 5.2.7.2.2 of TS 23.502 [3].

\* \* \* \* Next 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]).

- operator configurable UPF capability as described in clause 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.

\* \* \* \* Next change (all new text) \* \* \* \*

#### 5.8.2.X Operator configurable UPF capability

UPF may support operator defined non-standardarized or partially supported feature(s), such as hardware features (e.g. GPU, DPU information), computing features (e.g. computing resource type, computing capability), and protection features (e.g. Firewall, DDoS). If the UPF supports the above features, the UPF indicates the supported features to the SMF.

~~NOTE: The specific name and format of the parameter is to be determined by Stage 3.~~

~~The SMF selects the UPF supporting this feature via NRF or via N4 Association establishment, decribed in clause 6.3.3.2.~~

\* \* \* \* Next 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.

- Operator configurable UPF capability as described in clause 5.8.2.X.

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