**3GPP TSG WG2 Meeting #164S2-2408718**

**19 - 23 August 2024, Maastricht, Netherlands (revision of S2-2407768)**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **23.501** | **CR** | **5454** | **rev** | **1** | **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 Handling of Headers |
|  |  |
| ***Source to WG:*** | Ericsson, Nokia, Vodafone, ETRI |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | UPEAS\_Ph2 |  | ***Date:*** | 2024-08-07 |
|  |  |  |  |  |
| ***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)* |
|  |  |
| ***Reason for change:*** | The specification of KI#3 outcome Enhancement of UPF handling of headers according to approved WID: SP-240995 |
|  |  |
| ***Summary of change:*** | Changes to incorporate the agreed enhancements for KI#3 as in WID, as follows:- Enhance Nnef\_TrafficInfluence service to accommodate requests from AFs for Handling of payload headers according to Table 6.1.2.1-1 from TR 23.700-63. - Enhance the procedure in clause 4.3.6 of TS 23.502 to provision the handling information to the SMF/UPF- A new data subset in the Application data set is provisioned in the UDR.- NEF, PCF, SMF and UPF are enhanced to support the Handling of payload headers- UPF profile in NRF is enhanced with the new UPF capability to support the corresponding UPF selection and discovery- Enhancing Nupf\_EventExposure for Header/Tag reporting.- Enhancing N4 PFCP rules to instruct reporting of headers/tags handling upon AF request according to option 2 in TR 23.700-63. |
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| ***Consequences if not approved:*** | Handling of Headers Enhancements are not supported. |
|  |  |
| ***Clauses affected:*** | 5.6.x (new), 5.6.x.1 (new), 5.6.x.2 (new), 5.8.2.8.x (new), 5.8.5.6, 6.2.3 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 23.503 CR 4877, TS 23.502 CR 1329 |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |   |

\* \* \* \* 1st change (all new) \* \* \* \*

5.6.x Handling of PDU payload Headers

#### 5.6.x.1 General

Handling of PDU payload of Headers is an optional feature that allows exchange of information in-band in the traffic path between the application (in the UE or in the application server) and the 5GS. Handling of payload headers

NOTE 1: The handling of PDU payload of headers is not limited to a protocol element called header but can be any field or tag within a protocol

NOTE 2: Handling of payload headers enhances Header Enrichment (see clause 5.8.5.6) by allowing more actions than just insertion, that can be applied in uplink and in downlink directions.

The content of this clause applies to non-roaming and to Home Routed roaming scenario, i.e. to cases where the involved entities (AF, PCF, SMF, UPF) belong to the Home PLMN and the AF has an agreement with the Home PLMN.

The PCF controls Handling of payload headers in UPF by provisioning header handling information in the PCC Rules as described in clause 6.3.1 of TS 23.503 [45]. The PCF derives the header handling information in the PCC rule as described in 6.1.3.x of TS 23.503 [45] based on the AF request. SMF instructs UPF via N4 interactions..

Editor’s note: Whether SA2 should specify which packet processing rule to use is TBD.

The UPF performs Handling of payload headers (i.e. detection, reporting, insertion, replacement, or removal of headers/) and may notifie the UP Handling of Header events to SMF, to NEF/AF or to both as described below.

The Handling of Header/Tags request may include a request to UPF to report when a header handling action is performed. UPF event exposure service is used for reporting. The AF may request to receive Handling of payload headers reports (directly or via the NEF). By local policy the SMF may determine it should receive Handling of payload headers reports, irrespective of if the AF has requested Handling of payload headers reports. In this case the SMF subscribes to the UPF event exposure service for receiving Handling of payload headers reports, either implicitly via PFCP as specified in TS 29.244 [65] or via Nupf\_EventExposure Service. If both the AF and the SMF have subscribed to the UPF event exposure service for receiving Handling of Header/Tags reports the UPF sends the notifications to both the AF (optionally via the NEF) and the SMF.

NOTE 3: The actual mechanism in UPF for Handling of payload headers is implementation specific. As an example, UPF can use user plane encapsulation protocols that can be defined by other standard organizations.

#### 5.6.x.2 Application Function influence on Handling of payload headers

It is assumed that a service level agreement (SLA) exists between the operator and a third party. The mechanism(s) (e.g. protocol layer, type of encryption, etc.) to exchange information in-band in the traffic path using Handling of payload headers is agreed as part of the SLA. The reference to a system pre-configuration(s) corresponding to the mechanism to be applied for the AF request is also part of the SLA. The AF is required to provide it the refin the AF requests.

In the non-roaming scenario, Handling of payload headers, and Application Function influence on Service Function Chaining (as defined in clause 5.6.16) and Application Function influence on traffic routing (as defined in clause 5.6.7) can be applied simultaneously.

In the Home Routed roaming scenario, Handling of payload headers and Application Function influence on Service Function Chaining (as defined in clause 5.6.16) can be applied simultaneously.

The AF requests are sent to the PCF via N5 (in the case of requests targeting specific on-going PDU Sessions of individual UE(s), for an AF allowed to interact directly with the 5GC NFs) or via the NEF. The AF requests that target existing or future PDU Sessions of multiple UE(s) or of any UE are sent via the NEF and may target multiple PCF(s), as described in clause 6.3.7.2. The PCF(s) transform(s) the AF requests into policies that apply to PDU Sessions. When the AF has subscribed to UP Handling of Header event notifications, such notifications are sent by UPF either directly to the AF or via an NEF.

When the request is sent via NEF, Nnef\_TrafficInfluence service is used. The procedures for AF to request Handling of payload headers are described in clause 4.3.6 in TS 23.502 [3]. For AF interacting with PCF directly or via NEF, the AF requests may contain the information as described in the Table 5.6.x.2-1:

Table 5.6.x.2-1: Information element contained in AF request

|  |  |  |  |
| --- | --- | --- | --- |
| Information Name | Applicable for PCF or NEF (NOTE 1) | Applicable for NEF only | Category |
| Traffic Description | Defines the target traffic on which to apply handling of headers, represented by the combination of DNN and optionally S-NSSAI and application identifier or traffic filtering information. | The target traffic can be represented by AF-Service-Identifier, or by the combination of DNN and optionally S-NSSAI.  | Mandatory |
| Target UE Identifier(s) | Indicates the UE(s) that the request is targeting, i.e. an individual UE, a group of UE represented by Internal Group Identifier(s) (NOTE 2), or any UE accessing the combination of DNN, S-NSSAI | GPSI can be applied to identify the individual UE, or External Group Identifier can be applied to identify a group of UEs. | Mandatory |
| Spatial Validity Condition | Indicates that the request applies only to the traffic of UE(s) located in the specified location, represented by areas of validity. | The specified location can be represented by geographical area. | Optional |
| Temporal Validity Condition | Time interval(s) when the request applies or duration(s). | N/A | Optional |
| AF transaction identifier | The AF transaction identifier refers to the AF request. | N/A | Mandatory |
| **Handling of Headers Control information (UL/DL)** |
| Header Handling Reference  |  A reference that points to predefined configuration which defines in UPF how to perform header handling for this request (e.g. the protocol). | N/A | Mandatory |
| Header Handling Additional Data | Additional data to complement the UPF predefined configuration for the Header Handling Reference. (NOTE 3) | N/A | Optional |
| Header Handling Action(s) (NOTE 4) | The header handling action(s) requested on the target traffic.  | N/A | Optional |
| Header Handling Condition (NOTE 4) | It may be included to indicate if a requested action is to be performed always or once.  | N/A | Optional |
| Header/ Handling Direction (NOTE 4) | Indicates if the action applies to UL or DL direction. | N/A | Optional |
| Header Information (NOTE 4) | AF input to construct the headers to perform the Header Handling Action(s).  | N/A | Optional |
| Information on AF subscription to UP Handling of Header event | Indicates whether the AF subscribes to reporting of handling of header/tag execution and the parameters of this subscription. | N/A | Optional |
| NOTE 1: When the AF request targets existing or future PDU Sessions of multiple UE(s) or of any UE and is sent via the NEF, as described in clause 6.3.7.2, the information is stored in the UDR by the NEF and notified to the PCF by the UDR.NOTE 2: Internal Group ID can only be used by an AF controlled by the operator and only towards PCF.NOTE 3: The NEF, PCF and SMF do not need to understand the Header/Tag Handling Additional Data.NOTE 4: This information element is not needed if the predefined configuration for the Header Handling Reference includes that information. |

For each information element mentioned above as part of Handling of Headers control information in the AF request, a detailed description follows:

1) Header Handling Reference:

Reference agreed as part of the SLA that points to a predefined configuration in UPF which defines the header handling mechanism (e.g. protocol layer, type of encryption, etc) and how the Header/Tag Information is used to construct the header(s)/tag(s). 2) Header Handling Additional Data:

This additional data is not standardised, but it can be interpreted by UPF based on SLA. It is sent transparently by NEF, PCF and SMF to UPF. The In UPF, it complements the UPF predefined configuration for the Header Handling Reference.

3) Header Handling Action (s):

The action(s) that AF may request on the target traffic. One or more of the following can be requested:

- Report. It is used to request report of a detection of certain header. To detect UPF only considers the header name. An AF/NF can subscribe to UP Handling of Header event reporting to be notified upon detection. The report includes any value associated with the header.

- Remove. It can be used to request removal of certain header. Remove only considers the header name.

- Replace. It can be used to request replacement of certain header value. The header value to be replaced is detected by the header name. The header name is not modified, and the header value is replaced.

- Insert. It can be used to add certain header and when applicable, the associated value.

 When multiple actions are requested on the target traffic, the enforcement of the Header Handling Actions is done in the following order: Report, Remove, Replace, and Insert.

NOTE 1: Header name is an agreed identifier between the operator and 3rd-party and is settled as part of the SLA. For example, it can take the actual name of an HTTP header if HTTP is used.

NOTE 2: The execution order is relevant to build a request that has the intended impact on the traffic. For example, a header that is removed cannot be replaced.

For each Header Handling Action requested, the corresponding Header Information (see below) is also provided. When applicable, Header Handling Condition(s) (see below) may also be provided.

4) Header Handling Condition:

This defines how to apply the action. It may have one of the following values: for all detections or or the first detection of the action.

NOTE 3: In addition, Spatial Validity Condition and Temporary Validity Condition parameters in the request can be used to indicate that the request applies only in certain UE location (s) or during certain time interval respectively.

A Header Handling Condition may be provided for a Header Handling Action explicit in the request. For actions implicit in the Header Handling Reference, the header Handling Condition is included in the predefined configuration if applicable.

5) Header Handling Direction:

Header Handling Direction indicates to which direction the Header handling Control information applies to. Either uplink (UL) or downlink (DL).

6) Header Information:

 The Header Information contains input information to construct the Header(s) for the Header Handling Actions. AF may provide the Header Information using one or more of the following:

- Header Name and Header Value: Strings that UPF uses to build header name and header value according to the syntax of the protocol selected. For example, AF provides Header Name = path, and Header Value= domainX.com. Header Names are not standardised and they are based on local configuration and SLA.

In addition, AF may request a Header Name without requesting a Header Value. This is the case of information only known by the 5GC functions also on a per PDU basis. In such a case, the 5GC provides the actual Header Value. E.g. AF provides Header Name = RAT and SMF, based on session information and predefined configuration, sends to UPF header Name= RAT and header Value=NR.

Editor’s Note: it is FFS whether some use case requires additional alternatives for Header information, for example a Header Reference.

Header Information is provided for every explicit action included in the request.

7) Information on AF subscription to UP Handling of Header event:

 The AF may subscribe to receive reporting of handling of header execution from UPF (directly or via NEF), that is, when requested detection, removal, replacement or insertion of a header is performed by UPF. The AF subscription information may includes:

- Notification endpoint (including correlation id) of the consumer of the subscription.

- Reporting Frequency. The actions can be requested to be notified only once for the PDU session, periodically (in this case, a reporting period is also provided) or whenever the action is enforced. In the later case correlation applies to avoid reporting for each PDU.

- Reporting Suggestion Information as defined in clause 5.8.2.17 to reduce the UPF performance impacts.

The SMF may have a pre-configuration for the Header Handling Reference received from PCF. SMF checks the Header information received and adds Header values if needed according to its local configuration and session information before sending the header handling information to UPF.

NOTE 4: SMF can only add the Header values when it has the information.

The UPF checks whether it has the pre configuration for the Header Handling Reference received from SMF, and whether any header values still need to be determined by UPF. UPF performs Handling of payload headers as described earlier in this clause.

NOTE 5: It is left for UPF implementation how to solve any misalignment of the header of the handling information

The PCF sends the Information on AF subscription to notification of UP Handling of Header event to SMF if any has been received. The SMF sends the Notification target address for receiving event notifications to UPF. If SMF determines based on local configuration that it shall receive the notifications, it instructs UPF to duplicate the reporting and subscribes to the UPF event exposure service.

If AF does not provide any of the optional parameters above, then there may be a pre-configuration of such a parameter associated with the header handling reference.

\* \* \* \* 2nd change (all new) \* \* \* \*

#### 5.8.2.8.x Handling of Payload Headers by UPF

Handling of PDU payload of Headers is an optional feature of UPF.

When UPF receives a request for Handling of Header from SMF over N4, the request contains a Header Handling Reference which points to a predefined configuration in UPF which includes the details of the protocol where header handling shall be performed (e.g. HTTP). The interpretation of the reference is implementation specific. Handling of payload headersHeader

The Handling of Header request includes the header control information, which may contain explicit header handling actions to perform on the traffic detected which may be one or more of Report, Remove, Replace and Insert and conditions., see clause 5.6.x.

Handling of payload headersHandling of payload headersEeditor’s note: the following may or may not be included in final specification

Handling of payload headersHeaderHeader

\* \* \* \* 3rd 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.

- Handling of Headers as defined in clause 5.8.2.8.x.

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