**3GPP TSG-SA WG4 Meeting #129-eS4-241452**

**Online, 19 – 23 August 2024 revision of S4aR240038**

**Source: Nokia**

**Title: Solution KI#2: PSI signaling for lone PDUs**

**Agenda item: 10.6**

**Document for: Agreement**

# Introduction

In the SA4#127-bis-e, the key issue #2 on QoS handling requirements for lone PDU was incorporated into TR 26.822. The key issue proposes to study two aspects:

*- whether there is any issue when applying PDU Set QoS parameters to the lone PDUs from the application layer perspective?*

*- how to handle the issue of missing PDU Set Information in case of lone PDUs*

This contribution proposes a solution regarding the missing PDU Set Importance (PSI) for lone PDUs. The aim is to provide a session-specific PSI configuration by the Media Application Provider and use this mapping to set the PSI values rather than leaving the setting to a default configuration by the UPF.

This contribution is a revision of [S4aR240038](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/3GPP_SA4_AHOC_MTGs/SA4_RTC/Docs/S4aR240038.zip) presented in the RTC SWG telco on 26th June. For reference, the [minutes](https://docs.google.com/document/d/1lEJzfi6ZHCwnBzX0hHQbBp8l8M85odKw) are copied below.

Comments:

* Rufael: Shared some concerns on the email reflector. Mainly, SA4 should determine benefit from app/user perspective. PDU Set useful for high data rate, low-latency. For lone PDU how important is this PSI? What is the trade-off between app benefit and complexity of the solution?
* Serhan: Sender has best view of importance, so this solution enables sender to control the PSI setting in case of lone PDUs. Otherwise this is left to UPF. UPF may have no idea about app requirements.
* Thorsten: I share Rufael concerns. In addition, for low-bit rate streams does not make sense to use PDU Sets. Who is supposed to use PSI mapping information? UPF sees lone PDU, how is the UPF determine that it is AMR-WB/STUN etc.? How is this info supposed to be used then by the UPF?
* Serhan: This mapping is sent by the sender AF to the UPF. Network knows the different payload types/protocols.
* Thorsten: When RTP HE available payload type not necessary.
* Saba: Other comments?
* Qi: Observation #2: for audio and haptic, do we need to enable PDU Set for these? If we do not need why not separate into different QoS flows. This proposal seems too complicated. if the application intends to enable the PDU Set based QoS handling for the audio/haptic data, why not add the marks? For the overload issue, we may need to further think about how to derive all the PDU Set information, not only the PSI.
* Saba: Imed/Liangping still in queue - can we note and then revise. Imed/Liangping please add comments to notes.
* Imed: Good idea to tell UPF how to handle lone PDUs instead of letting it guess by itself. HOwever, this can be done via provisioning, so AF can send that for all sessions of a Provisioning session rather than get it from sender/receiver. Also we should not introduce any need for additional DPI, e.g. differentiating between RTCP report types, etc…
* Liangping: the examples in the paper make sense. However, if the sender wants the network to differentiate different types of packets, by assigning different values to the packets, a relative importance must be determined but it may be difficult to do so. Do we need to change the semantics of PSI in 26.522?

**This document addresses the above comments with a revised solution and new background and discussion sections that provide the basis for the proposed solution.**

Section 2 provides the background on PDU Set identification and provisioning in the 5G System.

Section 3 discusses the applicability of PDU Set handling for non-video media types and PDU Set identification at the UPF.

Section 4 provides a revised solution that utilizes the RTC Provisioning API. An analysis of the solution including the impacted 5G entities is provided.

# Background

# Guidelines for the PDU Set identification by the network

TS 26.522, Annex A contains guidelines for Network Functions like the UPF, which needs to determine PDU Set Information, as described in TS 23.501, clause 5.37.5. The guidelines in Annex A describe how a Network Function can obtain the PDU Set Information from RTP header extensions, RTP header and RTP payload, respectively.

When the PDU Set Information is present in an RTP header extension, the UPF only needs to parse the header extension and retrieve the information as provided by the application.

When an RTP HE with PDU Set Information is not provided by the sender, the UPF may derive some parts of the PDU Set Information from the (S)RTP header, as described in clause A.2.1. However, PDU Set Importance (PSI) cannot be obtained and PDU Set Size (PSSize) can only be obtained after the reception of the last PDU of the PDU Set. Also, the derivation in clause A.2.1 only applies for the case when a PDU Set is a video frame. It is not applicable to e.g. audio PDU Sets or to PDU Sets that are video slices.

When the RTP payload is not encrypted (i.e., SRTP is not used), the UPF may derive some parts of the PDU Set Information from the RTP payload. Clause A.2.2 describes how this can be done for RTP payloads carrying H.264/AVC and H.265/HEVC coded bitstreams. In summary, the UPF needs to parse the NAL unit header, which is the first one and two byte(s) of the RTP payload for H.264/AVC and H.265/HEVC, respectively. Similar to the derivation from the RTP header, the PSSize can only be obtained after the reception of the last PDU of the PDU Set. PSI can be obtained by using the same logic (i.e., parsing the NAL unit header) the RTP sender uses to populate the RTP HE for PDU Set marking, as described in the relevant guidelines in clause 4.2.6.2. However, this means more operations and thus more processing load for the UPF since it would need to check one or more of the NAL unit header fields. Also, such derivation is only possible for PDUs carrying coded video bitstreams and not for PDUs carrying other protocol data such as RTCP or other media types (e.g. audio, haptics).

# PDU Set provisioning in 5G media delivery

The generalized Media Delivery architecture that integrates 5GMS and RTC functionality in the 5G System is copied from TS 26.506 below for convenience.



5GMS and RTC architectures support dynamic policy instantiation that allow Media Clients to activate different traffic treatment and charging policies selected from a set of Policy Templates provisioned in its Provisioning Session. Policy templates are configured by the Media Application Provider for the media delivery sessions of a particular Provisioning Session and may be applied to downlink or uplink media delivery sessions using the Dynamic Policy API specified in clause 9.3 of TS 26.510.

In particular, the Media Application Provider populates the qoSSpecifications array in the Policy Template resource with objects of type *M1QosSpecification* and sets the *pduSetMarking* flag to indicate that Media Clients instantiating this Policy Template are required to apply PDU Set marking to media transport protocol PDUs falling within the scope of a Dynamic Policy Instance based on this Policy Template. The *pduSetMarking* flag is included in the Service Access Information that is exposed by the Media AF to the Media Session Handler via M5, as described in clause 5.3.2 of TS 26.510.

# To use the Dynamic Policy feature, a Media Session Handler instantiates a provisioned Policy Template and supplies a dynamic QoS specification to the Media AF, which combines this QoS specification with the information from the Policy Template to invoke the PCF/NEF. The Media Session Handler also provides an Application Flow Description to the Media AF, which is used by the Media AF to describe a Service Data Flow to the 5G Core for the purpose of application traffic detection. If the Policy Template indicates that PDU Set marking is enabled, the Media Session Handler also provides a *mediaTransportParameters* property in the Application Flow Description, which describes the set of media transport protocol parameters to be used by the 5G Core for PDU Set identification and/or end of data burst detection on this application flow.

TS 26.510 – Table 7.3.3.2-1: Definition of type ApplicationFlowDescription

|  |  |  |  |
| --- | --- | --- | --- |
| Property name | Data type | Cardinality | Description |
| filterMethod | SdfMethod | 1..1 | The filtering method used to identify packets belonging to this application flow (see clause 7.3.4.2). |
| packetFilter | IpPacketFilterSet | 0..1 | Description of the application flow in terms of packet header field values (see below). |
| domainName | string | 0..1 | Description of the application flow in terms of the Fully-Qualified Domain Name (FQDN) of the Media AS targeted at reference point M4 (see below). |
| mediaType | MediaType | 0..1 | The type of media carried by this application flow (see NOTE 1). |
| mediaTransport‌Parameters | Protocol‌Description | 0..1 | The set of media transport protocol parameters to be used by the 5G Core for the purpose of PDU Set identification and/or end of data burst detection on this application flow (see NOTE 2). |
| NOTE 1: Enumeration MediaType is specified in clause 5.6.3.3 of TS 29.514 [18].NOTE 2: Data type ProtocolDescription is specified in clause 5.5.4.13 of TS 29.571 [33]. |

The property *mediaTransportParameters* has the data type ProtocolDescription that is specified in TS 29.571, as shown in the table below. The Protocol Description may include the used transport protocol (e.g., RTP, SRTP), transport protocol header extensions (e.g. RTP HE for PDU Set marking), payload type and format (e.g., H.264, H.265) used by the Media Delivery session. It is used by the PCF to generate a Policy and Charging Control (PCC) rule that contains the PDU Set QoS parameters (PSDB, PSER, PSIHI).

TS 29.571 – Table 5.5.4.13-1: Definition of type ProtocolDescription

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| transportProto | MediaTransportProto | O | 0..1 | When present, this IE shall indicate the transport protocol used by the media flow.  |
| rtpHeaderExtInfo | RtpHeaderExtInfo | C | 0..1 | This IE shall be present if RTP or SRTP is used and the RTP payload packets contains a RTP Header Extension that can be used for PDU Set identification and/or End of Data Burst marking.When present, this IE shall contain information on the RTP header extension that can be used for PDU Set identification and/or End of Data Burst marking.(NOTE 1) |
| rtpPayloadInfoList | array(RtpPayloadInfo) | O | 1..N | When present, it shall contain RTP Payload information for the RTP stream, which can be used to derive the PDU Set information and/or End of Data Burst marking.(NOTE 1) (NOTE 2) |
| NOTE 1: If the rtpPayloadInfoList is present and contains one or more Payload Type values, the UPF may only parse the RTP packets with an RTP header containing any of these Payload Type value(s). Otherwise, if the rtpPayloadInfoList is absent or does not contain any Payload Type value, the UPF should parseall the RTP packets of the media flow and use either the RTP Header Extension if included, or the Payload format to derive the PDU set information (see Guidelines for PDU Set identification in clauses A.1 and A.2 of 3GPP TS 26.522 [59]).NOTE 2: In this release of the specification, the rtpPayloadInfoList contains only one RtpPayloadInfo element.NOTE 3: Vendor/operator specific attributes may be supported as defined in clause 6.6.3 of 3GPP TS 29.500 [25]. |

The attribute *transportProto* can have the values “RTP” and “SRTP” in Rel-18.

The attribute *rtpHeaderExtInfo* specifies the RTP HE type (e.g. “PDU\_SET\_MARKING” for the RTP HE for PDU Set marking defined in TS 26.522), identified of the RTP HE, format (1-byte or 2-byte) and whether the PSSize is present in the RTP HE.

The attribute *rtpHeaderPayloadInfoList* contains an array of objects of the type RtpPayloadInfo. Each such object contains the list of payload types (PT) in the RTP header (e.g. 96) and optionally the RTP payload format (e.g. “H265”). The structure RtpPayloadInfo is shown below.

TS 29.571 – Table 5.5.4.15-1: Definition of type RtpPayloadInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| rtpPayloadTypeList | array(integer) | C | 1..N | Integer between and including 1 and 127.This IE shall be present when the rtpPayloadFormat is present, otherwise it may be present.When present, this IE shall contain the list of Payload Type (PT) values in the RTP header of RTP packets the UPF may parse to derive the PDU Set Information.(NOTE) |
| rtpPayloadFormat | RtpPayloadFormat | O | 0..1 | When present, it shall indicate the RTP Payload format as defined in 3GPP TS 26.522 [59].(NOTE) |
| NOTE: The rtpPayloadType(s) shall correspond to the RTP Payload Format if the rtpPayloadFormat is present.  |

Following examples are given in TS 29.571 to illustrate the usage of ProtocolDescription:

|  |
| --- |
| EXAMPLE 1: For a media flow using RTP transport with:- the RTP Header Extension for PDU Set Marking (see clause 4.4.2 of 3GPP TS 26.522 [59]);- the RTP header extension Id "3";- RTP packets with different PTs, where packets with PT 96 contain the RTP Header Extension,the Protocol Description is set to: { "transportProto": "RTP", "rtpHeaderExtInfo": { "rtpHeaderExtType": "PDU\_SET\_MARKING", "rtpHeaderExtId": 3}, "rtpPayloadInfoList": [{ "rtpPayloadTypeList": [ 96 ]}]}EXAMPLE 2: For a media flow using RTP transport:- not using any RTP Header Extension for PDU Set identication;- H.265 payload format with Payload Types 96 and 97 (see clause A.2.3 (RTP with HEVC payload format) of 3GPP TS 26.522 [59]);the Protocol Description is set to: { "transportProto": "RTP", "rtpPayloadInfoList": [{"rtpPayloadFormat": "H265", "rtpPayloadTypeList": [96, 97]}]} |

# Real-time Media Communication provisioning API

The Real-time Media Communication provisioning API is used by the RTC Application Provider to provision configuration that will be relayed to the RTC Media Session Handler for usage with RTC sessions of that RTC Application Provider.

Data model for the *RTCConfiguration* is defined in clause 8.10 of TS 26.510, as shown below.

Table 8.10.3.1-1: Definition of RTCConfiguration resource

| Property name | Data Type | Cardinality | Description |
| --- | --- | --- | --- |
| edgeResources‌ConfigurationId | ResourceId | 0..1 | A reference to an Edge Resources Configuration resource (see clause 8.6.2).When present, indicates that the Media AS supporting this RTC Configuration shall be realised as a set of one or more EAS instances configured per the referenced resource. |
| enableStunService | boolean | 0..1 | If true, the Media AS shall provide a STUN service to the Media Session Handler for use in RTC-based media delivery sessions initiated in the context of the parent Provisioning Session.If false the Media Application Provider may populate the stunEndpoints property.If omitted, the default value shall be false. |
| stunEndpoints | array(M1‌Endpoint‌Access) | 0..1 | A list of one or more trusted STUN server endpoints populated by the Media Application Provider or else by the Media AF that may be used as ICE candidates for RTC-based media delivery sessions. |
| enableTurnService | boolean | 0..1 | If true, the Media AS shall provide a TURN service to the Media Session Handler for use in RTC-based media delivery sessions initiated in the context of the parent Provisioning Session.If false the Media Application Provider may populate the turnEndpoints property.If omitted, the default value shall be false. |
| turnEndpoints | array(M1‌Endpoint‌Access) | 0..1 | A list of one or more trusted TURN server endpoints populated by the Media Application Provider or else by the Media AF that may be used as ICE candidates for RTC-based media delivery sessions. |
| enableSwapService | boolean | 0..1 | If true, the Media AS shall provide a SWAP service to the Media Session Handler for use in RTC-based media delivery sessions initiated in the context of the parent Provisioning Session.If false the Media Application Provider may populate the swapEndpoints property.If omitted, the default value shall be false. |
| swapEndpoints | array(M1‌Endpoint‌Access) | 0..1 | A list of one or more trusted WebRTC Signalling Server endpoints populated by the Media Application Provider or else by the Media AF that support the SWAP protocol that may be used by the application for RTC-based media delivery sessions in the context of the parent Provisioning Session. |

# Discussion

# Applicability of PDU Set handling to media types other than video

It was commented during the RTC SWG telco that the PDU Set framework is only useful for high bitrate, low latency applications, and its benefit is questionable for media streams that contain low bitrate data, such as audio and haptics. In our view, this needs further analysis since this aspect was not discussed in detail in Rel-18 during 5G\_RTP Phase 1, resulting in some high-level guidelines for audio in TS 26.522.

In particular, TS 26.522 provides some guidelines for setting the PSI and PSSize for audio streams, as shown in the following excerpts:

TS 26.522 clause 4.2.6.2.1 on PSI:

|  |
| --- |
| PDU Sets that contain audio data should be assigned a lower PSI value (i.e., higher importance) compared with PDU Sets that contain other media types.NOTE 1: PDU Sets that carry immersive audio data are not necessarily assigned a lower PSI value compared with the other media PDU Sets. The PSI value of immersive audio PDU Sets is FFS.  |

TS 26.522 clause 4.2.6.3 on PSSize:

|  |
| --- |
| NOTE 6: The PDU Set Size guidelines above are generally applicable to video and audio media payload types. |

If SA4 decides that PDU Set handling should not be applied to PDUs of low bitrate streams such as audio, it would be necessary to reconsider the above guidelines in TS 26.522.

We expect this topic to be discussed and outcomes to be documented under the KI#13 objectives:

* Study and document applicability criteria of PDU Set marking to different media types and formats.
* Whether and how to apply PDU Set marking to non-video data: metadata, audio, text, image.

It might also be beneficial to consult with the RAN WGs to determine if data streams with characteristics other than high bitrate and low latency could benefit from PDU Set handling.

# PDU Set identification in the UPF

As described in the Background section, the UPF inspects the (S)RTP header of all incoming packets and uses the payload type (PT) field as a filter to determine which RTP packets it will further parse to retrieve the PDU Set Information.

If the payload type matches to one of those provided in the Protocol Description, the UPF either obtains the PDU Set Information directly from the RTP HE indicated in the *rtpHeaderExtInfo* attribute or derive some parts of it from the RTP header and/or payload (subject to encryption). The Protocol Description may also include a *rtpPayloadFormat* attribute which indicates to the UPF the association between the provided payload type(s) and a payload format.

The current version of the Protocol Description only allows description of the transport protocols RTP and SRTP. However, it can be used in future for other transport protocols and can be extended for detection of PDUs of other protocols, such as RTCP. The solution presented below explores such extension.

# Proposal

A solution to KI#2 is proposed for incorporation into TR 26.822. Relative to the TR, all text is new; change marks are shown against [S4aR240038](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/3GPP_SA4_AHOC_MTGs/SA4_RTC/Docs/S4aR240038.zip).

CHANGE 1 (all new)

6.X Solution #X: PSI signaling for lone PDUs

6.X.1 Key Issue mapping

This solution addresses the key issue #2.

6.X.2 Description

6.X.2.1 Background

As of Rel-18, there is no mechanism to mark PDUs carrying protocol data other than RTP. Thus, PDUs belonging to protocols such as RTCP, STUN, etc. cannot be marked.

In Rel-18, SA2 has agreed that the PSA UPF marks, in the downlink, each N6-unmarked PDU (“lone PDU”) with PDU Set Information into a PDU Set. If the UPF receives a PDU that does not belong to a PDU Set based on Protocol Description for PDU Set identification, the UPF still maps it to a PDU Set and determines the PDU Set Information by implementation-specific means.

NOTE: The solution to KI#4 in TR 23.700-70 enables the network to differentiate multiplexed streams sent in the same media transport such that they can be mapped into distinct QoS flows. However, in some cases this may result in unintended behavior, e.g. RTCP packets mapped to a different QoS flow would no longer measure the RTP media QoS flow characteristics which may result in errors e.g. in measuring the roundtrip delay using RTP sender/receiver reports. On the other hand, it could be problematic to apply the PDU Set QoS to lone PDUs, as described in the solution #2 in TR 26.822. How to balance this trade-off is FFS.

**Observation 1:** **PDUs of non-RTP protocols (e.g. RTCP) are mapped by the UPF into PDU Sets. The associated PDU Set Information is determined by the UPF.**

When the PDU Set Information is not provided by the sender in an RTP HE, the UPF may be able to reliably obtain some parts of the PDU Set Information based on the UPF implementation. Annex A of TS 26.522 describes how a Network Function can obtain the PDU Set Information from the RTP header and RTP payload, respectively.

When the RTP HE for PDU Set marking is not available, the UPF may derive some parts of the PDU Set Information from the (S)RTP header, as described in clause A.2.1 of TS 26.522. However, PDU Set Importance (PSI) cannot be obtained and PDU Set Size (PSSize) can only be obtained after the reception of the last PDU of the PDU Set. Also, the derivation in clause A.2.1 only applies for the case when a PDU Set is a video frame. It is not applicable to e.g. audio PDU Sets or PDU Sets that are video slices.

When the RTP payload is not encrypted (i.e., SRTP is not used), the UPF may derive some parts of the PDU Set Information from the RTP payload. Clause A.2.2 of TS 26.522 describes how this can be done for RTP payloads carrying H.264/AVC and H.265/HEVC coded bitstreams. In summary, the UPF needs to parse the NAL unit header, which is the first one and two byte(s) of the RTP payload for H.264/AVC and H.265/HEVC, respectively. Similar to the derivation from the RTP header, the PSSize can only be obtained after the reception of all PDUs of the PDU Set. PSI can be obtained by using the same logic the RTP sender uses to populate the RTP HE for PDU Set marking (i.e., parsing the NAL unit header), as described in the relevant guidelines in clause 4.2.6.2 of TS 26.522. However, this means more operations and thus more processing load for the UPF since it would need to check one or more of the NAL unit header fields. This is not feasible considering that the UPF processes data from several endpoints simultaneously under tight latency constraints.

**Observation 2: For RTP PDUs, if the RTP HE for PDU Set marking is not present, the UPF may derive some parts of the PDU Set Information from the RTP header or RTP payload (if unencrypted), albeit with some restrictions. In particular, PSI cannot be obtained from the RTP header, and deriving PSI from the RTP payload imposes a significant processing overhead for the UPF given its high processing load and tight latency constraints.**

Signaling the PDU Set Information in an RTP HE or deriving it from the RTP header/payload is not possible for PDUs carrying protocol data other than RTP (e.g. RTCP). Such PDUs are considered as lone PDUs by the UPF and placed into a PDU Set in a way that is determined by the UPF implementation. The UPF also has to define the PDU Set Information for the PDU Sets containing the lone PDUs. For some parts of the PDU Set Information (PSN, PSSN, End PDU), this opearation is straightforward.

For example, consider an RTCP PDU that is placed by the UPF into its own PDU Set (i.e., the PDU Set contains only that PDU). It is described below whether/how the PDU Set Information can be obtained for that PDU Set.

* Number of PDUs in the PDU Set (NPDS) is set to 1.
* PSN is set to 0 and the End PDU flag is set to 1 (since NPDS=1).
* PSSN is trickier since it depends on the transmission order of the PDU Set by the sender and is monotonically increased by the sender by 1 for each subsequent PDU Set. Since there is no gap between the PSSNs assigned by the sender for the RTP PDUs, the UPF would have to either assign an existing PSSN (i.e., a PSSN that is already used by another PDU Set) to the new PDU Set that contains the lone PDU, or a predetermined value that indicates that PSSN is undefined for that PDU Set.
* PSSize is equal to the size of the RTCP packet since that packet would be the only PDU in the PDU Set.
* To determine the PSI, the UPF must resort to preconfiguration (i.e. use a pre-defined value) since it has no means to obtain the PSI from the packet header or payload for non-RTP PDUs.

Any default PSI setting at the UPF may not be accurate since the importance of different PDU Sets is application- and codec-dependent. For example, some RTCP message types may be considered more important for low latency applications. In another example, RTCP feedback messages for viewport signaling may be crucial for the functionality of an immersive application, and thus it would be beneficial to be able to indicate a low PSI value for the RTCP packets carrying those.

Editor’s note: Other potential benefits and limitations of PDU Set handling for non-RTP protocol types (e.g. RTCP, STUN) is FFS.

**Observation 3: For lone PDUs, some parts of the PDU Set Information must be determined by the UPF. However, the UPF cannot reliably determine the PSI and may only assign a pre-defined PSI value (e.g. by the network operator). Sender applications are in the best position to determine the PSI.**

6.X.2.2 Solution description

In this solution, the Media Application Provider defines a mapping between a set of PSI values and non-RTP protocols that are used in the media delivery session.

The mapping can be provided using the RTC provisioning feature (TS 26.510, clause 5.2.10) of the media delivery session. In an example implementation, the Media Application Provider adds a property *lonePduInfoList* to the *RTCConfiguration* resource. The property *lonePduInfoList* contains an array of *lonePduInfo* objects as defined below.

**Definition of lonePduInfo object**

| Property name | Data Type | Cardinality | Description |
| --- | --- | --- | --- |
| protocol | string | 1..1 | Protocol information such as RTCP, STUN, etc. |
| packetType | integer | 0..1 | Packet type specific to the protocol. |
| feedbackMsgType | integer | 0..1 | RTCP feedback messages type [RFC 4585]. Can only be present if the protocol is RTCP. |
| pduSetImportance | integer | 1..1 | PSI value between 0 and 15 (inclusive). |

If a *lonePduInfoList* is provided, the Media AF extends themediaTransport‌Parameters property of the Application Flow Description that it has received from the Media Session Handler with the information in the *lonePduInfoList*. The Media AF then sends the Application Flow Description to the 5G Core, where themediaTransport‌Parameters (as Protocol Description) is passed to the UPF. For example, the Protocol Description may then have the following structure after addition of the property *lonePduInfoList*:

{ "transportProto": "RTP",

 "rtpPayloadInfoList": [{"rtpPayloadFormat": "H265", "rtpPayloadTypeList": [96]}],

 “**lonePduInfoList**:” [{"protocol": “RTCP”, "packetType": 206, “feedbackMsgType”: X, psi: 2},

 {"protocol": “RTCP”, "packetType": 207, psi: 10}],

}

In the example, the first *lonePduInfo* object provides the PSI mapping for RTCP packets that contain viewport feedback messages [TS 26.114, clause Y.7.2]. The RTCP feedback message is identified by Packet Type = 206, which refers to payload-specific feedback message [RFC 4585]. FMT (feedback message type) is set to the value ‘X’ for viewport feedback messages. The second *lonePduInfo* object provides the PSI mapping for RTCP Extended Reports (XR) messages identified by Packet Type = 207 [RFC 3611]. In this example, the Media Application Provider chooses to assign PSI=2 to viewport feedback messages and PSI=10 to RTCP XR messages.

NOTE: There may be PDUs carrying other protocol data such as STUN in the media delivery session. Whether/how a PSI mapping should be provided for such PDUs is FFS.

After receiving the Protocol Description, the UPF can determine the PSI for lone PDUs based on the information provided in each *lonePduInfo* object.

Editor’s note: Potential benefits and limitations of PDU Set handling for media streams that do not require both high bitrate and low latency (e.g., audio, haptics) are FFS and will be documented under KI#13.

6.X.2.3 Analysis of the solution

The benefit of the proposed solution is that the UPF does not have to rely on a pre-defined value (e.g. provided by the network operator) to determine the PSI for lone PDUs and can make a more reliable decision based on a PSI mapping provided by the Media Application Provider.

In terms of UPF processing, complexity is not increased because the UPF only needs to inspect the packet headers (e.g. the RTCP header) to check for packet type.

Benefits of the solution are summarized below.

* More dynamic solution as it allows applications to set PSI value for specific unmarked traffic instead of using a fixed value for all applications pre-configured at the UPF.
* More reliable as applications are in a better position to determine the importance of PDU Sets.
* Reuses the RTCConfiguration mechanism. Requires the UPF to determine the PSI value for lone PDUs at the start of session based on RTCConfiguration.
* Extensible to other types of unmarked packets in the future.

The impacted entities in the 5G System are:

**Real-time Media Provisioning API:**

* *RTCConfiguration* provided by the Media Application Provider is extended with the lone PDU information.

**Media AF:**

* Receives the extended *RTCConfiguration* and adds it to the Application Flow Description.

**UPF:**

* Receives the extended Protocol Description and parses the *lonePduInfoList* property to retrieve the PSI mapping for lone PDUs.

Editor’s Note: This solution requires coordination with SA2.

# References

[RFC 3611] “RTP Control Protocol Extended Reports (RTCP XR)”

[RFC 4585] “Extended RTP Profile for Real-time Transport Control Protocol (RTCP)-Based Feedback (RTP/AVPF)”

[TS 23.501] “System architecture for the 5G System (5GS)”

[TR 23.700-70] “Study on architecture enhancement for Extended Reality and Media service (XRM); Phase 2”

[TS 26.510] “Media delivery; interactions and APIs for provisioning and media session handling”

[TS 26.522] “5G Real-time Media Transport Protocol Configurations”

[TS 29.571] “5G System; Common Data Types for Service Based Interfaces; Stage 3”