**SA WG2 Meeting #149eS2-220xxxx**

**February 14th – 25th, 2022; Elbonia (revision of S2-220)**

**Source: Nokia, Nokia Shanghai Bell**

**Title:**  **Key Issue for QoS framework enhancement based on media unit**

**Document for: Approval**

**Agenda Item:**  **9.19**

**Work Item / Release: FS\_XRM / Rel-18**

*Abstract of the contribution: This paper proposes a KI to address Work Tasks #3.2 and #3.3*

# Discussion

The FS\_XRM SID contains the following Work Task:

WT#3: Study whether and how the following QoS and policy enhancements for XR service and media service transmission are performed:

* WT#3.1: Study the traffic characteristics of media service enabling improved network resources usage and QoE.
* WT#3.2: Enhance QoS framework to support media units granularity (e.g., video/audio frame/tile, Application Data Unit, control information), where media units consist of PDUs that have the same QoS requirements.
* WT#3.3: Support differentiated QoS handling considering different importance of media units. e.g., eligible drop packets belong to less important media units to reduce the resource wasting.

NOTE2: Coordination with RAN WGs may be needed for the above bullets.

* WT#3.4: Whether and how to support uplink-downlink transmission coordination to meet RTT (Round-Trip Time) latency requirements between UE and N6 termination point at the UPF.
* WT#3.5: Potential policy enhancements to minimize the jitter, focusing on i.e. requirement provisioning from AF, extension of PCC rule.

WT#3.2 and WT#3.3 address the scenario where 5GS QoS instead of operating on the granularity of IP packets should be able to operate on the granularity of media units, which are application layer PDUs that may be carried as fragments within multiple IP packets.

At the moment the 5G QoS framework operates on the granularity of traffic flows consisting of IP packets that are identifiable by an IP 6-tuple consisting of IP source address, IP destination address, DSCP, protocol, source port and destination port.

Identifying individual media units, or IP packets carrying the fragments of a specific media unit within a traffic flow typically requires inspection of the application protocol headers beyond TCP and UDP headers, as it is dependent on the application (or transport) protocol in use, such as RTP, HTTP or QUIC (which can by itself carry RTP or HTTP). Use of transport or application layer encryption, such as TLS, DTLS or Secure RTP will further hamper this effort. Proprietary protocols are also used where the identification may require reverse engineering of the protocol.

Even though the challenges exist, it may still make sense to standardize the identification rules for specific standard protocols such as RTP, where the IETF is working on standardizing how to encode media unit and media unit importance information in the RTP headers [1]

While the identification of the media units is at least partially application protocol specific and in some cases will require proprietary methods, once the identification is done, it is possible to generalize the identification information via classification and standardize how it is mapped to 5GS QoS concepts such as QoS flows, how it is carried between CN and RAN, and how it is used for QoS differentiation and enforcement in RAN or in transport networks.

IP packets may be classified according to the identified media units they contain. The classification information may be promulgated with the IP packet to QoS enforcement points where treatment is provided based on the per-packet classification and QoS policy. This requires augmenting the current QoS framework to allow QoS policy for each classification. For example, in a video media flow, I-Frames and P-Frames may receive different classification markings. QoS policy could specify a PER dependent on the classifications (presumably a lower PER for I-Frames). The policy could be promulgated to the NG-RAN via a QoS Profile and applied according to classification markings in received packets.

Thus, it seems sensible to some extent decouple how the identification, classification, and policy for QoS treatment.

References:

[1] Frame marking RTP header extension, IETF Internet-Draft, AVTCore WG, https://datatracker.ietf.org/doc/draft-ietf-avtext-framemarking/

# 2 Proposal

**It is proposed to update TR 23.700-60** **as follows**

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

## x.1 Key Issue #X: 5G QoS framework enhancement considering media unit

x.1.1 Description

The objective of this Key Issue is study and enhance the 5GS Quality of Service framework to provide differentiated QoS at the granularity of application layer media units, and to differentiate QoS for application layer media units based on their importance.

The objective can be broken down to the following requirements:

1. Enablers to identify which IP packets within an IP traffic flow carry the fragments of a specific media unit, where a media unit has application specific characteristics that require a certain QoS handling in the 5GS.
2. Enablers to classify the identified packets and to use classification information for appropriate QoS differentiation and optimized scheduling
3. Enablers to specify the treatment that is provided according to classifications, and send treatment information to QoS enforcement points (e.g. to the NG-RAN via a QoS Profile).
4. Enablers to support differentiated QoS based on the classification of a packet and a corresponding specified treatment.

Point 1 is dependent on the exact application and transport protocols used to carry the media units on top of UDP or TCP, such as RTP, specific RTP payload formats (e.g., for H.264 or H.265 video), HTTP, QUIC, or even proprietary. 3GPP defined media unit identification for select protocols as well as enabling proprietary methods (e.g. AL/ML based) for media unit identification inside and outside of the 5GS should be considered.

Point 2 (packet classification) requires media unit awareness from Point 1. Options for providing classification information inside the 5GS , and outside of the 5GS (e.g.: via DSCP marking) for the case when media identification and classification is external may be considered.

Point 3 allows the 5GS to determine the handling of the packet at QoS enforcement points, e.g.: according to operator policy.

Once the identification and classification w.r.t. points 1 and 2 has been done, and the policy for handling classified packets is known, Point 4 allows the 5GS to apply the requested packet handling according to packet classification markings, and should not require application protocol awareness.

Based on this, for this Key Issue the following areas should be studied:

* Which entities within 5GS are responsible for media unit identification and how are they configured to perform identification of which IP packets within an IP traffic flow carry fragments of a specific media unit.
  + Whether media unit identification configuration should outside the scope of 3GPP, except for specific standard application protocols such as RTP.
  + How the end points for UL and DL such as UPF or UE respectively, may be configured to perform the identification
  + Whether and how the existing mechanisms in the 5G QoS framework, such as N4 Packet Detection Rules (PDRs), UE QoS rules, Session Management signalling or NEF AFSesionWithQoS API are extended to provide media unit identification information for specific standard application protocols such as RTP
* How in the 5GS should classification of identified packets be performed and how should classification information can be transported to enforcement points.
  + Whether and how classification information is provided to QoS enforcement points for appropriate QoS differentiation.
  + If UPF is doing the identification and classification, how is the classification information carried to the RAN so that it can be leveraged by RAN for optimized scheduling based or other specified treatment.
* Support in the 5GS for functions outside of the 5GS performing media unit identification and packet classification, and how classification information can be transported.
  + How classification information may be carried to the 5GS from application end points or intermediate functions performing the identification and classification
* How to specify the treatment that is to be provided to classified packets to enable per-packet QoS
  + How this can be done by extending the current policy and QoS framework.
* How is the classification information and specified treatment used within 5GS for the purposes of QoS enforcement and differentiation.
  + Mapping to the appropriate QoS flows
  + Optimized scheduling within a QoS flow based on packet classification
  + QoS differentiation within a QoS flow based on packet classification