Title: Response to *LS on 3GPP 5G System support for integration with IEEE TSN networks*
From: IEEE 802.1
For: Action
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Dear Colleagues,

The IEEE 802.1 Working Group would like to thank 3GPP SA Working Group 2 (SA2) for the information on SA2 work related to TSN. We are glad for your interest in leveraging TSN technology. In response to your liaison statement S2-1908630, please find summary information below. Going beyond this level of details may require further communication between our organizations.

Regarding Issue 1, if the 5GS logical bridge only supports Scheduled Traffic[1] then the CNC does not provide ingress port information in addition to egress port information in the configuration of an 802.1Q-compliant bridge; however, IEEE Std 802.1Q-2018 already provides ingress port capabilities and Per-Stream Filtering and Policing (PSFP). PSFP relies on the stream identification methods specified by IEEE Std 802.1CB-2017, which could "facilitate identification of unique PDU Session in the uplink".

Important details: PSFP was originally specified by IEEE Std 802.1Qci-2017 and is also part of IEEE Std 802.1Q-2018. (Unless otherwise specified, all subsequent references are with respect to IEEE Std 802.1Q-2018, hereafter referred to as 802.1Q.) If supported, PSFP equips a Bridge or an end station with capabilities that allow filtering and policing decisions to be made on a per-stream basis for received frames. PSFP relies on the stream identification methods specified by IEEE Std 802.1CB-2017. IEEE 802.1 standards specify the externally observable behavior of Bridges and end stations. 802.1Q also provides an architectural model for Bridges; however, several choices are left to the implementer as long as the externally observable behavior remains conformant to the standard. For instance, an implementer has some freedom on where to locate the Bridge forwarding process functions of Figure 8-12, including the location of some of the PSFP components. As described in subclause 8.6.5.1.2, PSFP intends to support deployments where the transmission and reception of frames at each Bridge across a network are coordinated such that frames are received by a Bridge only when the corresponding stream gate is open in the given Bridge. This operation prevents undesired frame reception by a Bridge, e.g., for protection against malfunctioning devices or malicious streams. Implementing PSFP stream gates at the ingress ports of a Bridge would provide such protection. Note that the time-based operation of a stream gate (relative to a known time scale) is very similar to that of a transmission gate but with different granularity, i.e., a transmission gate is per traffic class whereas a stream gate can be per stream: see, e.g., Figure 8-13 vs. Figure 8-14. These two figures also illustrate a significant difference between the two types of gates: there is a queue upfront of each transmission gate but there is no queue upfront of a stream gate. Thus, a frame is dropped if received while the corresponding stream gate is in the Closed state whereas a frame is queued while the corresponding transmission gate is in the Closed state. Therefore, the capabilities provided by

[1] Scheduled Traffic was originally specified by IEEE Std 802.1Qbv-2015 and is now part of IEEE Std 802.1Q-2018 which is, as other IEEE 802 standards, freely available via the IEEE Get Program.

PSFP seem to be a good candidate to resolve Issue 1. For instance, if the 5GS logical bridge supports PSFP, then the deployment can be operated in a manner where the ingress port capabilities of PSFP are leveraged and the CNC can configure PSFP to provide ingress port information in case of the fully centralized TSN configuration model.

Regarding Issue 2, 802.1Q provides per "QoS Flow" Scheduled Traffic and also already provides per stream time-based operations with Per-Stream Filtering and Policing (PSFP). If the 5GS logical bridge supports both Scheduled Traffic and PSFP, then the CNC also supports both with the fully centralized model specified in IEEE Std 802.1Qcc. PSFP capabilities may also be considered to be leveraged for efficient radio scheduling.

Important details: Scheduled Traffic operations are specified per queue as described in subclause 8.6.8.4. As illustrated in Figure 8-12, the architectural model of an 802.1Q Bridge places queues and frame queuing at the transmission port, i.e., at the egress port to which the MAC relay function forwards a given frame for transmission. As described in subclause 8.6.6, the Bridge forwarding process provides one or more queues for a given Bridge port, each queue corresponding to one of at most eight traffic classes (as limited by the 3-bit Priority Code Point (PCP) field of VLAN tags). A Scheduled Traffic transmission gate applies to a given queue. Therefore, the time-based operation (relative to a known time scale) of such transmission gate cannot go beyond the granularity of traffic classes. Note that, as described in subclause 8.6.8.4, in order for an end station to support Scheduled Traffic, its transmission selection has to operate as if it was an outbound port of a Bridge that supports Scheduled Traffic. This means that an end station implementing Scheduled Traffic also operates on a per traffic class basis; however, as pointed out in subclause 46.2.3.5 in IEEE Std 802.1Qcc-2018 (referred to as 802.1Qcc in the following), although Scheduled Traffic specifies a valid implementation of a time-aware Talker, the optional TSpecTimeAware group is intended to support alternate scheduling implementations for time-aware Talkers. This means that 802.1Qcc adds a new capability to 802.1Q for end stations to be able to provide per stream time offsetting. Some differences exist between a Talker end station and a Bridge. The Talker is the source of a stream, knows a lot of details about the stream, includes OSI layers higher than Layer 2, potentially runs the application that generates the stream, hence may have some control on packet generation, etc. In contrast, Bridge operations are limited to OSI Layer 2 and a Bridge cannot have the same amount of information or control on a stream as a Talker. Thus, 5GS operating as a logical bridge cannot be expected to be provided with the same amount of information and control on a stream as a Talker; however, as explained for Issue 1, 802.1Q already provides per stream time-based operations relative to a known time scale, namely, PSFP stream gates. Furthermore, the CNC configures stream gates in case of the fully centralized TSN configuration. Therefore, PSFP capabilities may be considered to be leveraged for efficient radio scheduling. (We may also mention here the ongoing P802.1Qcr Asynchronous Traffic Shaping (ATS) project which operates on finer granularity than a traffic class although does not provide time-based scheduling relative to a known time scale, i.e., the Bridges operate asynchronously; they are not time synchronized but use their local time.)

We would be grateful if SA2 would inform us on SA2 work related to IEEE 802.1 standards and ongoing projects. We look forward to maintaining dialogue and cooperation between our organizations. Please note that IEEE 802.1 can only provide official communication such as liaison letters from IEEE 802 Plenary meetings. The IEEE 802 work is open and contribution-driven. Participation is on an individual basis; therefore, technical discussion can be conducted based on individual contributions at face-to-face meetings and on calls. IEEE 802.1 face-to-face meeting details are available at: http://www.ieee802.org/1/meetings. The next face-to-face meeting is September 16-20, 2019, in Edinburgh, UK. Details on TSN calls are available at https://1.ieee802.org/tsn-calls.

Respectfully submitted,
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