**SA WG2 Meeting #S2-143E S2-210xxxx**

**24 February - 9 March 2021, Electronic, Elbonia (revision of S2-210xxxx)**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
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|  | **<Spec#>** | **CR** | **<CR#>** | **rev** | **<Re#>** | **Current version:** | **<Version#>** |  |
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| *For* ***HE******LP*** *on using this form: comprehensive instructions can be found at http://www.3gpp.org/Change-Requests.* |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | KI#2, adding impacts due to IP PDU session |
|  |  |
| ***Source to WG:*** | ZTE |
| ***Source to TSG:*** | SA WG2 |
|  |  |
| ***Work item code:*** | IIoT |  | ***Date:*** | 2021-01-20 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-17 |
|  | *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. | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)Rel-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
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| ***Reason for change:*** |  |
|  |  |
| ***Summary of change:*** |  |
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| ***Consequences if not approved:*** |  |
|  |  |
| ***Clauses affected:*** |  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

*FIRST CHANGE*

5.27 Time Sensitive Communications

5.27.0 General

This clause describes 5G System features that support TSC and allow the 5G System to be integrated transparently as a bridge in an IEEE 802.1 TSN network.

During the PDU Session establishment, the UE shall request to establish a PDU Session as an always-on PDU Session, and the PDU Sessions used for TSC are established as Always-on PDU session as described in clause 5.6.13. In this release of the specification:

- Home Routed PDU Sessions are not supported for TSC services;

- TSC PDU Sessions are supported only with IP and Ethernet PDU Session type and SSC mode 1;

- Service continuity for TSC PDU Sessions is not supported when the UE moves from 5GS to EPS.

*Next CHANGE*

### 5.27.2 TSC Assistance Information (TSCAI)

5.27.2.1 Support of IEEE TSN

In this clause, the 5GS functions acts as one or more TSN Bridges of the TSN network. Only Ethernet PDU sessions are supported.NOTE 1: This clause assumes that PSFP information as defined in IEEE Std 802.1Q [98] and Table 5.28.3.1-1is provided by CNC. PSFP information may be provided by CNC if TSN AF has declared PSFP support to CNC. TSN AF indicates the support for PSFP to CNC only if all the DS-TT and NW-TT ports of the 5GS Bridge have indicated support of PSFP. Means to derive TSCAI if PSFP is not supported by 5GS and/or the CNC are beyond the scope of this specification.

TSC assistance information describes TSC traffic characteristics for use in the 5G System. The knowledge of TSN traffic pattern is useful for the gNB to allow it to more efficiently schedule periodic, deterministic traffic flows either via Configured Grants, Semi-Persistent Scheduling or with dynamic grants. TSC assistance information, as defined in Table 5.27.2-1, is provided from SMF to 5G-AN, e.g. upon QoS Flow establishment. The TSCAI parameters are set according to corresponding parameters obtained from the TSN AF, when available. The TSN AF may be able to identify the ingress port and thereby the PDU session as described in clause 5.28.2.

The TSN AF interfaces towards the CNC for the PSFP (IEEE Std 802.1Q [98]) managed objects that correspond to the PSFP functionality implemented by the DS-TT and the NW-TT. Thus, when PSFP information is provided by the CNC, the TSN AF may extract relevant parameters from the PSFP configuration. The TSN AF calculates traffic pattern parameters (such as burst arrival time with reference to the ingress port and periodicity). TSN AF also obtains the flow direction as specified in clause 5.28.2. TSN AF is responsible for forwarding these parameters in TSC Assistance Container to the SMF (via PCF). TSN AF may enable aggregation of TSN streams if the TSN streams belong to the same traffic class, terminate in the same egress port and have the same periodicity and compatible Burst arrival time. One set of parameters and one container are calculated by the TSN AF for multiple TSN streams to enable aggregation of TSN streams to the same QoS Flow.

Annex I describe how the traffic pattern information is determined.

NOTE 2: Further details of aggregation of TSN streams (including determination of burst arrival times that are compatible so that TSN streams can be aggregated) are left for implementation.

In this case, TSN AF creates one TSC Assistance Container for the aggregated TSN streams. The SMF will bind PCC rules with a TSC Assistance Container as described in clause 6.1.3.2.4 of TS 23.503 [45]. The SMF derives TSCAI on a per QoS Flow basis and sends it to 5G-AN. The Burst Arrival Time and Periodicity component of the TSCAI that the SMF signals to the 5G-AN are specified with respect to the 5G clock. The SMF is responsible for mapping the Burst Arrival Time and Periodicity from a TSN clock to the 5G clock based on the time offset and cumulative rateRatio between TSN time and 5GS time as measured and reported by the UPF.

The TSCAI parameter determination in SMF is done as follows:

- For traffic in downlink direction, the SMF corrects the Burst Arrival Time in the TSN Assistance Container based on the latest received time offset measurement from the UPF and sets the TSCAI Burst Arrival Time as the sum of the corrected value and CN PDB as described in clause 5.7.3.4, representing the latest possible time when the first packet of the data burst arrives at the AN.

- For traffic in uplink direction, the SMF corrects the Burst Arrival Time in the TSN Assistance Container based on the latest received time offset measurement from the UPF and sets the TSCAI Burst Arrival Time as the sum of the corrected value and UE-DS-TT Residence Time, representing the latest possible time when the first packet of the data burst arrives at the egress of the UE.

- The SMF corrects the Periodicity in the TSN Assistance Container by the previously received cumulative rateRatio from the UPF and sets the TSCAI Periodicity as the corrected value.

- The SMF sets the TSCAI Flow Direction as the Flow Direction in the TSN Assistance Container.

NOTE 3: In order for the TSN AF to get Burst Arrival Time, Periodicity on a per TSN stream basis, support for IEEE Std 802.1Q [98] (as stated in clause 4.4.8.2) Per-Stream Filtering and Policing (PSFP) with stream gate operation is a prerequisite.

In the case of drift between TSN GM clock and 5G clock, the UPF updates the offset to SMF using the N4 Report Procedure as defined in TS 23.502 [3] clause 4.4.3.4. In the case of change of cumulative rateRatio between TSN time and 5G time, the UPF updates the cumulative rateRatio to SMF using the N4 Report Procedure as defined in TS 23.502 [3] clause 4.4.3.4. The SMF may then trigger a PDU Session Modification as defined in TS 23.502 [3] clause 4.3.3 in order to update the TSCAI to the NG-RAN without requiring AN or N1 specific signalling exchange with the UE.

NOTE 4: In order to prevent frequent updates from the UPF, the UPF sends the offset or the cumulative rateRatio only when the difference between the current measurement and the previously reported measurement is larger than a threshold as described in TS 23.502 [3] clause 4.4.3.4.

The SMF may update the TSCAI to the NG-RAN as part of handover procedure as defined in TS 23.502 [3] clauses 4.9.1.2.2 and 4.9.1.3.2.

Table 5.27.2-1: TSC Assistance Information

|  |  |
| --- | --- |
| Assistance Information | Description |
| Flow Direction | The direction of the TSC flow (uplink or downlink). |
| Periodicity | It refers to the time period between start of two bursts. |
| Burst Arrival time | The latest possible time when the first packet of the data burst arrives at either the ingress of the RAN (downlink flow direction) or egress interface of the UE (uplink flow direction). |

5.27.2.2 Support of TSC exposure

The TSC exposure is described in the clause 5.3x. There is no TSN network for TSC exposure. The IP or Ethernet PDU sessions are supported for TSC exposure.

The NEF get the service service requirements and traffic pattern from AF. The NEF calculates the TSCAI and send to NG-RAN which is similar with TSN AF in the clause 5.27.2.1. The differences are:

- The NEF uses the UE IP address/ID from AF to identify the N5 association related to the PDU session of UE/DS-TT.

- The NEF uses the flow description to determine the Flow Direction.

- The Periodicity and Burst Arrival time are provided by AF directly.

For UE-UE communication, the NEF divides the stream into one uplink stream and one or more downlink according to the flow description.

- For downlink stream, the Flow Direction is set to downlink, the burst arrival time is set to sum of burst arrival time of the UL stream and 5GS delay of PDU session carrying the UL stream.

*Next CHANGE*

### 5.27.5 5G System Bridge delay

In order for the 5G System to participate as a TSN bridge according to transmission gate schedules specified, the 5GS Bridge is required to provide Bridge Delays as defined in IEEE Std 802.1Qcc [95] for each port pair and traffic class of the 5GS bridge to an IEEE 802.1 TSN system. In order to determine 5GS Bridge Delays, the following components are needed:

1. UE-DS-TT Residence Time: the time taken within the UE and DS-TT to forward a packet between the UE and DS-TT port. UE-DS-TT Residence Time is provided at the time of PDU Session Establishment by the UE to the network.

NOTE 1: UE-DS-TT Residence Time is the same for uplink and downlink traffic and applies to all traffic classes.

2. Per traffic class minimum and maximum delays between the UE and the UPF/NW-TT that terminates the N6 interface (including UPF and NW-TT residence times), independent of frame length that a given 5GS deployment supports. The per-traffic class delays between the UE and the UPF/NW-TT are pre-configured in the TSN AF (see clause 5.28.4).

The TSN AF calculates the 5GS independentDelayMin and independentDelayMax values for each port pair and for each traffic class using the above components.

The dependentDelayMin and dependentDelayMax for 5GS Bridge specify the time range for a single octet of an Ethernet frame to transfer from ingress to egress and include the time to receive and store each octet of the frame, which depends on the link speed of the ingress Port as per IEEE Std 802.1Qcc [95].

NOTE 2: Further details how TSN AF determines dependentDelayMin and dependentDelayMax are up to implementation.

Since Residence times may vary among UEs and per traffic class delay between the UE and the UPF/NW-TT may vary among UPFs, the 5GS Bridge Delay is determined after the PDU Session Establishment for the corresponding UPF and the UE by the TSN AF. The TSN AF deduces the related port pair(s) from the port number of the DS-TT Ethernet port and port number of the NW-TT Ethernet port(s) of the same 5GS Bridge when the TSN AF receives the 5GS Bridge information for a newly established PDU Session and calculates the bridge delays per port pair.

*END OF CHANGES*