**SA WG2 Meeting #156E (e-meeting) S2-230XXXX**

**April 17 – 21, 2023**

**Source: vivo**

**Title: Discussion on how AF provide periodicity to SMF**

**Document for: Approval**

**Agenda Item: 9.12.2**

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

*Abstract of the contribution: it discuss how AF provide periodicity to SMF and give example for CR changes.*

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| --- |
| 1 DiscussionEditor’s note: The method used to provide the Periodicity information to SMF is FFS. |

As introduced by rel17 IIOT and defined in 23503 i00, the AF (not TSN AF) provides the parameters of traffic characteristics (i.e. periodicity, etc.) to the 5GS. When the AF is untrusted, the NEF forward those parameters to the TSCTSF to generate TSC Assistance Container. The PCF forwards the TSC Assistance Container received from the TSCTSF to the SMF.

When XRM is introduced, **there used to be a proposal to let AF to generate TSC Assistance Container carrying the periodicity and forward it the 5GS.** For this proposal, the following concerns have been received:

* Concern1：The AF has supported to provide parameters (i.e. periodicity, etc.) of traffic characteristics to 5G network. In theory, parameters of traffic characteristics are possible be provided to the PCF directly when the AF is trusted. Why the AF repeat to provide TSC Assistance Container.
* Concern2：The proposal makes both AF and TSCTSF generate TSCAC and work is repeated.
* Concern3：TSC Assistance Container literally is used for TSC scenario and is not sufficiently forward compatible to the non-TSC traffic. It can be foreseen more and more traffic characteristic information may be considered in the network and the traffic can be non-TSC, so the TSC Assistance Container is not sufficiently forward compatible.

**In order to fix the above concerns, way forward proposal-l is as following：**

* For better forward compatibility and with consideration the TSC feature has not used in the real business yet, consider a new name for the container without the restriction of TSC: e.g. rename TSC Assistance Container Traffic Assistance Container and make it suitable for both TSC and non-TSC scenarios.
* The AF always provides the Assistance Container instead of the parameters of traffic characteristics.
* Remove TSCTSF’s behaviour for generating the Assistance Container. Instead, the TSCTSF forward the received container to the PCF.

NOTE X: If the WF proposal 1 cannot be agreed, different handling should be considered for TSN and non TSN scenario for how AF provides traffic characteristics (i.e. periodicity, etc.) to the SMF.

# 2 The main changes for WF proposal-1 for example

# <Main changes in 23.503 >

#### 6.1.3.22 AF session with required QoS

The AF may request that a data session to a UE is set up with a specific QoS (e.g. low latency or jitter) and priority handling. The AF can request the network to provide QoS for the AF session based on the service requirements with the help of a QoS Reference parameter that refers to pre-defined QoS information. Instead of the QoS Reference, the AF may provide individual QoS parameters associated to the Flow Description.

a) When the AF provides only a QoS Reference to determine the QoS parameters but no individual QoS parameters:

- When the PCF authorizes the service information from the AF, it derives the QoS parameters of the PCC rule based on the service information and the indicated QoS Reference.

NOTE 1: A SLA has to be in place between the operator and the ASP defining the possible QoS levels and their charging rates. For each of the possible pre-defined QoS information sets, the PCF needs to be configured with the corresponding QoS parameters and their values as well as the appropriate Charging key (or receive this information from the UDR).

- The AF may change the QoS by providing a different QoS Reference while the AF session is ongoing. If this happens, the PCF shall update the related QoS parameter sets in the PCC rule accordingly.

b) When the AF provides individual QoS parameters instead of a QoS Reference:

- The AF provides one or more of the following individual QoS parameters, i.e. Requested Priority, Maximum Burst Size, Requested 5GS Delay, Requested Maximum Bitrate, Requested Guaranteed Bitrate and Requested Packet Error Rate.

NOTE 2: Different combinations of individual QoS parameters with specific parameter names exist and they are described in TS 23.501 [2] (for Time Sensitive Communication), in clause 6.1.3.23 (for integration with Time Sensitive Networking) and in TS 29.514 [36].

- If the AF request for QoS is sent via the TSCTSF and the request contains a Requested 5GS Delay, the TSCTSF determines a Requested PDB considering the UE-DS-TT Residence Time (either provided by the PCF or pre-configured).

- When the PCF authorizes the service information from the AF, it derives the QoS parameters of the PCC rule based on the service information and the individual QoS parameters received from the AF and TSCTSF. The PCF should select a standardized, pre-configured or existing dynamically assigned 5QI that matches the individual QoS parameters. If no 5QI exists that matches the individual QoS parameters, the PCF generates a new dynamically assigned 5QI based on the individual QoS parameters.

- The AF may change the QoS by providing different values for the individual QoS parameters while the AF session is ongoing. If this happens, the PCF shall update the related QoS parameter sets in the PCC rule accordingly.

- The PCF may reject the individual QoS parameters received from the AF based on operator policy or impossibility to support the requested values of the individual QoS parameters. If this happens, the PCF may provide in the response to the AF one or more combinations of individual QoS parameters that can be supported.

In addition to the QoS Reference or the individual QoS parameters described above, the AF may provide further parameters associated with the Flow Description, e.g. Traffic Assistance Container that describe traffic characteristics as described in clause 5.27.2 of TS 23.501 [2].

The PCF generates a PCC Rule with service data flow filter (including IP Packet Filter set as in clause 5.7.6.2 of TS 23.501 [2]) or Ethernet Packet Filter set as in clause 5.7.6.3 of TS 23.501 [2]) derived from the Flow Descriptions provided by the AF, the derived PCC rule QoS parameters such a 5QI, ARP, GBR and MBR (see clause 6.3.1 for all possible PCC rule QoS parameters) and the associated TSC Assistance Container as received from the TSN AF, AF or TSCTSF.

For TSC QoS, the PCF derives the 5QI value as defined in clause 5.27.3 of TS 23.501 [2], the PCF derives the MBR using the Requested Maximum Bitrate provided by the AF and sets the GBR equal to the MBR unless the AF provides a Requested Guaranteed Bitrate, in which case the MBR and GBR are set separately.

If the PCF gets informed about Policy Control Request Triggers relevant for the AF session, the PCF shall inform the AF about it as defined in clause 6.1.3.18.

If an AF session can adjust to different QoS parameter combinations, the AF may provide Alternative Service Requirements in a prioritized order (indicating the preference of the QoS requirements with which the service can operate) in addition to the QoS Reference or individual QoS parameters. Alternative Service Requirements contain:

- When the AF requests the network to provide QoS with a QoS Reference, one or more QoS Reference parameters in a prioritized order.

- When the AF requests the network to provide QoS with individual QoS parameters, one or more Requested Alternative QoS Parameter Set(s) in a prioritized order. Each Requested Alternative QoS Parameter Set is comprised of the following individual parameters: Requested 5GS Delay, Requested Guaranteed Flow Bitrate and Requested Packet Error Rate.

If the AF request is sent via the TSCTSF, the TSCTSF determines a Requested PDB considering the Requested 5GS Delay and the UE-DS-TT Residence Time.

An AF that provides Alternative Service Requirements shall also subscribe to receive notifications from the PCF for successful resource allocation and when the QoS targets can no longer (or can again) be fulfilled as described in clause 6.1.3.18.

When the PCF authorizes the service information from the AF and generates a PCC rule, it shall also derive Alternative QoS Parameter Sets for this PCC rule based on the QoS Reference parameters or the Requested Alternative QoS Parameter Sets in the Alternative Service Requirements. If the AF provided Requested Alternative QoS Parameter Sets in the request, the PCF may reject any of the Requested Alternative QoS Parameter Sets it has received based on operator policy or impossibility to support the requested values of the individual parameters. If this happens, the PCF may provide in the response to the AF one or more Requested Alternative QoS Parameters Sets that can be supported.

The PCF shall enable QoS Notification Control and include the derived Alternative QoS parameter sets (in the same prioritized order indicated by the AF) in the PCC rule sent to the SMF. When the PCF notifies the AF that QoS targets can no longer be fulfilled, the PCF shall include the QoS Reference parameter or the set of Requested Alternative QoS Parameters corresponding to the Alternative QoS parameter set referenced by the SMF, or an indication that the lowest priority QoS Reference or the lowest priority set of Requested Alternative QoS Parameters of the Alternative Service Requirements cannot be fulfilled (as described in clause 6.1.3.18).

NOTE 3: The AF behaviour is out of the scope of this TS but can include adaptation to the change of QoS (e.g. rate adaptation) as well as application layer signalling with the UE.

The AF may change the Alternative Service Requirements while the AF session is ongoing. If this happens, the PCF shall update the Alternative QoS parameter sets in the PCC rule accordingly.

The AF may indicate to the PCF that the UE does not need to be informed about changes related to Alternative QoS Profiles. With this indication received from the AF, the PCF decides whether to disable the notifications to the UE when changes related to the Alternative QoS Profiles occur and sets the Disable UE notifications at changes related to Alternative QoS Profiles parameter in the PCC rule accordingly.

#### 6.1.3.23a Support of Time Sensitive Communication and Time Synchronization

Enablers for Time Sensitive Communication and Time Synchronization are defined in TS 23.501 [2] clause 5.27.

In the case of integration with IEEE TSN network, the TSN AF interacts with the PCF as described in clause 6.1.3.23.

When the PCF has the 5GS Bridge information for the PDU Session received from SMF and has a subscription for the 5GS Bridge information Notification from the TSCTSF or the PCF determines that the PDU Session is potentially impacted by (g)PTP based time synchronization service based on a local policy, if integration with IEEE TSN does not apply, the PCF provides the following parameters to the TSCTSF:

- 5GS user-plane Node information:

- 5GS Bridge ID;

- UE-DS-TT Residence time;

- port number of the DS-TT;

- MAC address of the Ethernet port of DS-TT (i.e. DS-TT port MAC address) (for Ethernet type PDU Session), or IP address of the UE (for IP type PDU Session, additionally DNN and S-NSSAI of IP type PDU Session in the case of private IPv4 address being used for the PDU Session);

- Port Management Information Container and the related port number;

- User plane node Management Information Container.

Upon reception of the above information, if the TSCTSF does not have a corresponding AF session, the TSCTSF shall create an AF session with the PCF.

The TSCTSF may receive a request from an AF that a data session to a UE is to be set up for Time Sensitive Communication with a specific QoS and the Traffic Assistance Container (as described in clause 5.27.2.3 of TS 23.501 [2]). If so, the TSCTSF provides the Flow Descriptions, the TSC Assistance Container (as described in clause 5.27.2.3 of TS 23.501 [2]), and the related QoS information to the PCF by setting up an AF session with required QoS as described in clause 6.1.3.22. In addition, the TSCTSF may provide the following parameters to the PCF:

- Port Management Information Container and related Port number as applicable.

- User plane node Management Information Container.

The TSCTSF may use the PTP Port state of NW-TT and DS-TT in the Port/User plane node Management Information Container to determine the Port Pairs that will be used for (g)PTP delivery. Based on this the TSCTSF may request appropriate QoS treatment for the (g)PTP flows from PCF.

The AF may include the Capability for BAT adaptation or a BAT Window in the request (as described in clause 5.27.2.3 of TS 23.501 [2]).The PCF sends the BAT offset received from the SMF to the AF and the AF adjusts the burst sending time according to the indicated BAT offset.

# < Main changes in 23. 501>

### 5.27.2 Traffic Assistance Information (TAI) and Traffic Assistance Container (TAC)

#### 5.27.2.1 General

TSC Assistance Information (TSCAI) is defined in Table 5.27.2-1 and describes TSC traffic characteristics for use in the 5G System. TSCAI may be used by the 5G-AN, if provided by SMF. The knowledge of TSC traffic pattern is useful for 5G-AN as it allows more efficiently scheduling of QoS Flows that have a periodic, deterministic traffic characteristics either via Configured Grants, Semi-Persistent Scheduling or with Dynamic Grants.

The AF determines the TSC Assistance Container (defined in Table 5.27.2-2)and provides it to the PCF for IP type and Ethernet type PDU Sessions. In the case of integration with IEEE TSN network, the TSN AF determines TSC Assistance Container as described in clause 5.27.2.2 and provides it to the PCF for Ethernet PDU Sessions. The PCF receives the TSC Assistance Container from the TSCTSF or the TSN AF and forwards it to the SMF as part of PCC rule as described in clause 6.1.3.23a of TS 23.503 [45].

The SMF binds a PCC rule with a TSC Assistance Container to a QoS Flow as described in clause 6.1.3.2.4 of TS 23.503 [45]. The SMF uses the TSC Assistance Container to derive the TSCAI for that QoS Flow and sends the derived TSCAI to the NG-RAN. The Periodicity, Burst Arrival Time, and Survival Time components of the TSCAI are specified by the SMF with respect to the 5G clock. The SMF is responsible for mapping the Burst Arrival Time and Periodicity from an external clock (when available) to the 5G clock based on the time offset and cumulative rateRatio (when available) between the external clock time and 5GS time as measured and reported by the UPF. The SMF determines the TSCAI as described in clause 5.27.2.4.

A Survival Time, which indicates the time period an application can survive without any data burst, may be provided by TSN AF/AF either in terms of maximum number of messages (message is equivalent to all packets of a data burst) or in terms of time units. Only a single data burst is expected within a single time period referred to as the periodicity.

The SMF may send an update of the TSCAI to the NG-RAN as defined in clauses 4.3.3.2, 4.9.1.2.2 and 4.9.1.3.2 of TS 23.502 [3].

Table 5.27.2-1: T Assistance Information (TAI)

|  |  |
| --- | --- |
| 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 data bursts. |
| Burst Arrival Time (optional) | The latest possible time when the first packet of the data burst arrives at either the ingress of the RAN (downlink flow direction) or the egress of the UE (uplink flow direction). |
| Survival Time (optional) | Survival Time, as defined in TS 22.261 [2], refers to the time period an application can survive without any data burst. |
| Burst Arrival Time Window (BAT Window) (optional)  (NOTE 1) (NOTE 2) | Indicates the acceptable earliest and latest arrival time of the first packet of the data burst at either the ingress of the RAN (downlink flow direction) or the egress of the UE (uplink flow direction). |
| Capability for BAT adaptation (optional) (NOTE 1) | Indicates that the AF will adjust the burst sending time according to the network provided Burst Arrival Time offset (see clause 5.27.2.5). |
| NOTE 1: Only one of the parameters (BAT Window or Capability for BAT adaptation) can be provided.  NOTE 2: The parameter will only be provided together with Burst Arrival Time. | |

Table 5.27.2-2: Traffic Assistance Container (TAC)

|  |  |
| --- | --- |
| 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 data bursts. |
| Burst Arrival Time (optional) | The time when the first packet of the data burst arrives at the ingress port of 5GS for a given flow direction (DS-TT for uplink, NW-TT for downlink). |
| Survival Time (optional) | It refers to the time period an application can survive without any data burst, as defined in TS 22.261 [2]. |
| Time Domain (optional) | The (g)PTP domain of the TSC flow. |
| Burst Arrival Time Window (BAT Window) (optional)  (NOTE 1) (NOTE 2) | Indicates the acceptable earliest and latest arrival time of the first packet the data burst at the ingress port of 5GS for a given flow direction (DS-TT for uplink, NW-TT for downlink). |
| Capability for BAT adaptation (optional) (NOTE 1) | It indicates that the AF will adjust the burst sending time according to the network provided Burst Arrival Time offset (see clause 5.27.2.5). |
| NOTE 1: Only one of the parameters (BAT Window or Capability for BAT adaptation) can be provided.  NOTE 2: The parameter will only be provided together with Burst Arrival Time. | |

#### Void

#### 5.27.2.4 TSCAI determination based on Traffic Assistance Container

The SMF determines the TSCAI (defined in Table 5.27.2-1) for the QoS Flow based on the TSC Assistance Container of the PCC rule bound to the QoS Flow. This clause is applicable irrespective of whether the TSC Assistance Container is determined by the TSN AF or by the TSCTSF.

The Burst Arrival Time and Periodicity component of the TSCAI that the SMF sends to the 5G-AN are specified with respect to the 5G clock. The SMF is responsible for mapping the Burst Arrival Time and Periodicity in the TSC Assistance Container from an external clock to the 5G clock based on the time offset and cumulative rateRatio (when available) between external time and 5GS time as measured and reported by the UPF. The SMF may correct the TSCAI based on the UPF report for time offset and cumulative rateRatio between external PTP 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 Traffic 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 TSC 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. How the SMF corrects the Burst Arrival Time if the UE-DS-TT Residence Time has not been provided by the UE is up to SMF implementation.

- The SMF corrects the Periodicity in the TSC Assistance Container using the cumulative rateRatio if the cumulative rateRatio was previously received from the UPF and sets the TSCAI Periodicity as the corrected value. Otherwise, the SMF sets the received Periodicity in the TSCAI without any correction.

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

- If Survival Time is provided in terms of maximum number of messages, the SMF converts maximum number of messages into time units by multiplying its value by the TSCAI Periodicity, and sets the TSCAI Survival Time to the calculated value. If Survival Time is provided in time units, the SMF corrects the Survival Time using the cumulative rateRatio if the cumulative rateRatio was previously received from the UPF and sets the TSCAI Survival Time to the corrected value. Otherwise, SMF sets the TSCAI Survival Time without correction.

- If the TSC Assistance Container contains a BAT Window, the SMF sets and corrects the indicated earliest and latest possible arrival time of the first packet in the same way it is described for the correction of the Burst Arrival Time above.

- If the TSC Assistance Container contains a Capability for BAT adaptation, the SMF sets the Capability for BAT adaptation in the TSCAI.

Depending on whether the Time Domain is provided in the TSC Assistance container, SMF may perform the following:

- the SMF provisions the UPF/NW-TT to report the clock drifting between 5G clock and the external GM clock for the (g)PTP time domain number that is configured to the NW-TT.

- the SMF provisions the UPF/NW-TT to report the clock drifting between 5G clock and the external GM clock for the given Time Domain number.

The SMF uses the N4 Association Setup or Update procedures as described in clause 4.4.3 of TS 23.502 [3] to provision the UPF to report the clock drifting.

If the SMF has clock drift information for a Time Domain and if the Time Domain matches with the Time Domain in the TSC Assistance Container (i.e. clock drift between 5G timing and AF supplied Time Domain determined based on UPF reporting), or Time Domain information is not provided in the TSC Assistance Container, then the SMF may adjust the TSCAI information so that it reflects the 5GS Clock as described in clause 5.27.2.1.

If the SMF does not have synchronization information for a requested Time Domain in the TSC Assistance Container, or the Time Domain in the TSC Assistance Container is set to a value = "5GS", then the TSCAI information will be used without adjustment.

In the case of drift between external GM clock and 5G clock, the UPF updates the offset to SMF using the N4 Report Procedure as defined in clause 4.4.3.4 of TS 23.502 [3]. If the cumulative rateRatio is available and in the case of change of cumulative rateRatio between external PTP time and 5G time, the UPF updates the cumulative rateRatio to SMF using the N4 Report Procedure as defined in clause 4.4.3.4 of TS 23.502 [3]. The SMF may then trigger a PDU Session Modification as defined in clause 4.3.3 of TS 23.502 [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 clause 4.4.3.4 of TS 23.502 [3].

# < Main changes in 502>

#### 5.2.6.9 Nnef\_AFsessionWithQoS service

##### 5.2.6.9.1 General

See clause 4.15.6.6.

This service is also used to support subscription and notification of QoS Monitoring for URLLC, as described in clause 5.33.3.2 of TS 23.501 [2].

This service is also used to support subscription and notification of BAT offset for the AF that supports adjusting burst sending time based on RAN feedback, as described in clause 5.27.2.5 of TS 23.501 [2].

##### 5.2.6.9.2 Nnef\_AFsessionWithQoS\_Create service operation

**Service operation name:** Nnef\_AFsessionWithQoS Create

**Description:** The consumer requests the network to provide a specific QoS for an AF session.

**Inputs, Required:** AF Identifier, UE address (i.e. IP address or MAC address), Flow description information as described in clause 6.1.3.6 of TS 23.503 [20] or External Application Identifier, QoS Reference or individual QoS parameters as described in clause 6.1.3.22 of TS 23.503 [20].

**Inputs, Optional:** time period, traffic volume, Alternative Service Requirements (containing one or more QoS Reference parameters or Requested Alternative QoS Parameter Sets in a prioritized order), QoS parameter(s) to be measured, Reporting frequency, Target of reporting and optional an indication of local event notification as described in clause 6.1.3.21 of TS 23.503 [20], DNN if available, S-NSSAI if available, Traffic Assistance Container.

**Outputs, Required:** Transaction Reference ID, result.

**Output (optional):** None.

##### 5.2.6.9.5 Nnef\_AFsessionWithQoS\_Update service operation

**Service operation name:** Nnef\_AFsessionWithQoS Update

**Description:** The consumer requests the network to update the Service Requirement(s) and/or additional Alternative Service Requirement(s) for an AF session.

**Inputs, Required:** Transaction Reference ID.

**Inputs, Optional:** Flow description information (as described in clause 6.1.3.6 of TS 23.503 [20]), QoS Reference or individual QoS parameters as described in clause 6.1.3.22 of TS 23.503 [20], time period, traffic volume, Alternative Service Requirements (containing one or more QoS Reference parameters or Requested Alternative QoS Parameter Sets in a prioritized order), QoS parameter(s) to be measured, Reporting frequency, Target of reporting and optional an indication of local event notification as described in clause 6.1.3.21 of TS 23.503 [20], Traffic Assistance Container.

**Outputs, Required:** Result.

**Output (optional):** None.

##### 5.2.27.3.2 Ntsctsf\_QoSandTSCAssistance\_Create operation

**Service operation name:** Ntsctsf\_QoSandTSCAssistance\_Create

**Description:** The consumer requests the network to provide a specific QoS for an AF session.

**Inputs, Required:** AF Identifier, UE address, Flow description(s) or External Application Identifier, QoS Reference or individual QoS parameters as described in clause 6.1.3.22 of TS 23.503 [20].

**Inputs, Optional:** sponsored data connectivity information if applicable, Alternative Service Requirements (containing one or more QoS Reference parameters or Requested Alternative QoS Parameter Set(s) in a prioritized order), QoS parameter(s) to be measured, Reporting frequency, Target of reporting as described in clause 6.1.3.21 of TS 23.503 [20], DNN if available, Traffic Assistance Container.

**Outputs, Required:** Transaction Reference ID, result.

**Output (optional):** None.

##### 5.2.27.3.3 Ntsctsf\_QoSandTSCAssistance\_Update operation

**Service operation name:** Ntsctsf\_QoSandTSCAssistance\_Update

**Description:** The consumer requests the network to update the QoS and/or additional Alternative QoS for an AF session.

**Inputs, Required:** Transaction Reference ID.

**Inputs, Optional:** Flow description, QoS Reference or individual QoS parameters as described in clause 6.1.3.22 of TS 23.503 [20], sponsored data connectivity information if applicable, Alternative Service Requirements (containing one or more QoS Reference parameters or Requested Alternative QoS Parameter Set(s) in a prioritized order), QoS parameter(s) to be measured, Reporting frequency, Target of reporting as described in clause 6.1.3.21 of TS 23.503 [20], Traffic Assistance Container.

**Outputs, Required:** Result.

**Output (optional):** None.