**3GPP TSG-SA2 Meeting #143E *<TDoc#>***

 **Feb 24th - March 9th, 2021**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **23.501** | **CR** | **<CR#>** | **rev** | **-** | **Current version:** | **16.7.0** |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **X** | Core Network | **X** |

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|  |
| ***Title:***  | KI#3B-1: Exposure of Time synchronization as a service  |
|  |  |
| ***Source to WG:*** | Nokia, Nokia Shangai Bell |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | IIoT |  | ***Date:*** | 2021-01-21 |
|  |  |  |  |  |
| ***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](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | This contribution addresses the following item in the work plan:* KI#3B-1: Impact to exposure procedure to introduce Time Sync activation/deactivation

SA2 FS\_IIoT study has concluded the support for exposure of Time synchronization service and it need to be captured in TS 23.501. The principles to be included are from TR 23.700-20 clause 8.3 “Key Issue #3B: Exposure of Time Synchronization”:1) AF can learn 5GS capabilities to support time synchronization, request time synchronization with specified requirements, and supply information that can be used to optimize and configure time synchronization procedure for connected devices.2) Time Synchronization service, policy and charging control can be provided for Ethernet PDU sessions and IP PDU sessions. This service is applicable for deployments without TSN integration, for these deployments, the NEF may be used instead of TSN AF |
|  |  |
| ***Summary of change:*** | Capture the overall general description of time synchronization activation/deactivation support in 23.501 |
|  |  |
| ***Consequences if not approved:*** | Agreed conclusion not specified as part of the work item. |
|  |  |
| ***Clauses affected:*** |  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR … CR … |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

---Start of the 1st Change---

##### 5.8.2.11.14 TSC Management Information

The following table describes the TSC Management Information Container (TSC MIC) that includes BMIC, PMIC and the associated NW-TT port number.

Table 5.8.2.11.13-1: TSC Management Information Container

|  |  |  |
| --- | --- | --- |
| Attribute | Description | Comment |
| Bridge Management Information Container | 5GS TSN Bridge information exchanged transparently between NW-TT and TSN AF or NEF via 5GS (as in Table 5.28.3.1-2). |  |
| Port Management Information Container | Information exchanged transparently between NW-TT and TSN AF or NEF via 5GS (as in Table 5.28.3.1-1). |  |
| NW-TT Port Number | NW-TT Port Number related to the PMIC. | Included when the PMIC information is present. |

---Start of the 2nd Change---

## 5.20 External Exposure of Network Capability

The Network Exposure Function (NEF) supports external exposure of capabilities of network functions. External exposure can be categorized as Monitoring capability, Provisioning capability, Policy/Charging capability and Analytics reporting capability. The Monitoring capability is for monitoring of specific event for UE in 5G System and making such monitoring events information available for external exposure via the NEF. The Provisioning capability is for allowing external party to provision of information which can be used for the UE in 5G System. The Policy/Charging capability is for handling QoS and charging policy for the UE based on the request from external party. The Analytics reporting capability is for allowing an external party to fetch or subscribe/unsubscribe to analytics information generated by 5G System.

Monitoring capability is comprised of means that allow the identification of the 5G network function suitable for configuring the specific monitoring events, detect the monitoring event, and report the monitoring event to the authorised external party. Monitoring capability can be used for exposing UE's mobility management context such as UE location, reachability, roaming status, and loss of connectivity. AMF stores URRP-AMF information in the MM context to determine the NFs that are authorised to receive direct notifications from the AMF. UDM stores URRP-AMF information locally to determine authorised monitoring requests when forwarding indirect notifications. In order to time synchronization services, the NEF may monitor events at the NW-TT regarding IEEE Std 1588 [107] or IEEE Std 802.1AS [104] configuration operation as specified in clause 5.27.1.3.

Provisioning capability allows an external party to provision the Expected UE Behaviour or the 5G-VN group information or AF influence on time synchronization information or service specific information to 5G NF via the NEF. The provisioning comprises of the authorisation of the provisioning external third party, receiving the provisioned external information via the NEF, storing the information, and distributing that information among those NFs that use it. The externally provisioned data can be consumed by different NFs, depending on the data. In the case of provisioning the Expected UE Behaviour, the externally provisioned information which is defined as the Expected UE Behaviour parameters in TS 23.502 [3] clause 4.15.6.3 or Network Control parameter TS 23.502 [3] clause 4.15.6.3a consists of information on expected UE movement, Expected UE Behaviour parameters or expected Network Configuration parameter. The provisioned Expected UE Behaviour parameters may be used for the setting of mobility management or session management parameters of the UE. In the case of provisioning the 5G-VN group information the externally provisioned information is defined as the 5G-VN group parameters in TS 23.502 [3] clause 4.15.6.7, and it consists of some information on the 5G-VN group. In order to provision the time synchronization parameters, the procedure to external information is defined in TS 23.502 clause 4.15.6.9, and it consist of information regarding the time synchronization service requirements and operation within the 5GS. The affected NFs are informed via the subscriber data update as specified in TS 23.502 [3] clause 4.15.6.2. The externally provisioned information which is defined as the Service Parameters in clause 4.15.6.7 of TS 23.502 [3] consists of service specific information used for supporting the specific service in 5G system. The provisioned Service Parameters may be delivered to the UEs. The affected NFs are informed of the data update.

Policy/Charging capability is comprised of means that allow the request for session and charging policy, enforce QoS policy, and apply accounting functionality. It can be used for specific QoS/priority handling for the session of the UE, and for setting applicable charging party or charging rate.

Analytics reporting capability is comprised of means that allow discovery of type of analytics that can be consumed by external party, the request for consumption of analytics information generated by NWDAF.

An NEF may support CAPIF functions for external exposure as specified in clause 6.2.5.1.

An NEF may support exposure of NWDAF analytics as specified in TS 23.288 [86].

---Start of the 4th Change---

#### 5.27.1.3 AF influence on Time Synchronization

5GS supports time synchronization service that can be influenced by AF. The AF may learn 5GS capabilities to support time synchronization and request to influence time synchronization distribution configuration that can be used to optimize and configure time synchronization procedure for targeted UE(s). The AF controls activation and deactivation of the time synchronization service for the target UE(s). Time synchronization service is characterized by the following criteria:

* Time synchronization method:
	+ IEEE Std 1588 [107] operation (i.e. as a Boundary Clock, peer-to-peer Transparent Clock, or end-to-end Transparent Clock)
	+ IEEE Std 802.1AS [104] operation
	+ 5G internal system clock.
* Time synchronization parameters:
	+ Time synchronization accuracy requirement.
	+ Time Domain.
	+ DS-TT capabilities: whether the DS-TT is GM capable with the GM attributes as defined in IEEE Std 1588 [107] or IEEE Std 802.1AS [104].
	+ IEEE Std 1588 [107] or IEEE Std 802.1AS [104] configuration: required PTP device type, (g)PTP message rate (initial Sync interval, initial Announce interval), (g)PTP timeout parameters (Sync message timeout, Announce message timeout), GM priority, clock identity, and clock quality.
* Subscription to time synchronization monitoring events: Better Announce message received, BMCA result, current PTP port states, changes to current PTP port states, Sync or Announce receipt timeout expiry.

The NEF exposes the 5GS capabilities to support time synchronization service to the AF or TSN AF. The exposed information may include supported time synchronization distribution methods, (g)PTP GM clock quality and clock identity if applicable, and minimum time synchronization accuracy supported.

The AF or TSN AF requests sent to the NEF may target a UE or multiple UEs. The request may include the following information:

* Target UE(s) Identification. This may correspond to:
	+ Individual UEs identified using GPSI, or an IP address/Prefix or a MAC address.
	+ Any UE accessing the combination of DNN, S-NSSAI and DNAI(s).
* Requested synchronization accuracy.
* Requested time synchronization distribution method.
* Time Domain.
* IEEE Std 1588 [107] or IEEE Std 802.1AS [104] configuration, if applicable.
* Spatial Validity Condition on the UE(s) location as described in clause 5.6.7.1.
* Information on AF or TSN AF subscription to corresponding time synchronization monitoring events.

The NEF uses the Time Synchronization service parameters received from AF to compose the Time Synchronization service policy. When IEEE Std 1588 [107] or IEEE Std 802.1AS [104] have been selected as distribution method, the NEF determines the necessary (g)PTP parameters to activate and control the service in DS-TT(s) and NW-TTs. For this purpose, the NEF uses the PMIC or BMIC to manage the IEEE Std 1588 [107] or IEEE Std 802.1AS [104] operation in the DS-TT or NW-TT, respectively (see clause 5.28.3).

The DS-TT may indicate to the NEF (or TSN AF) inside a PMIC whether DS-TT is capable of acting as (g)PTP GM, GM attributes and which IEEE Std 1588 [107] or IEEE Std 802.1AS [104] operation version(s) it supports.

The NEF (or TSN AF) via PMIC or BMIC configuration may perform the following actions with the TTs:

* Request the NW-TT or DS-TT(s) to activate (g)PTP residence time calculation.
* Request the NW-TT or DS-TT(s) (if the DS-TT has indicated that is is capable of acting as a (g)PTP GM) to generate (g)PTP Sync, Follow\_Up and Announce messages.
* Configure the NW-TT or DS-TT(s) (g)PTP operation: timestamping, (g)PTP message rate (initial Sync interval, initial Announce interval), (g)PTP timeout parameters (Sync message timeout, Announce message timeout).
* Configure the NW-TT BMCA operation if enabled.
* Subscribe to NW-TT time synchronization monitoring events.

The AF or TSN AF service request information is stored in the UDR by the NEF and notified to the PCF by the UDR. The NEF is responsible of updating or revoking the service information at the UDR. If the AF or TSN AF request targets future PDU Sessions, the NEF may store the information in the UDR until the target UE(s) establishes the PDU Session, or a new AF or TSN AF request to deactivate the service is received.

For handling (g)PTP traffic, the PCF, according to PCC rule authorization, chooses a 5QI and dynamically set the PDB and/or MDBV according to requirements for (g)PTP protocol. The PCF provides the SMF with a PCC rule generated based on the AF request. The SMF may take the information in the PCC rule to may decide to modify or establish a PDU Session to create or modify or release a QoS flow for transmitting the (g)PTP messages. The PCF acknowledges the time synchronization service request to the NEF and the NEF replies the AF with the result.

---Start of the 5th Change---

### 5.28.3 Port and bridge management information exchange in 5GS

#### 5.28.3.1 General

For IEEE TSN integration, port and bridge management information is exchanged between CNC and TSN AF. The port management information, is related to Ethernet ports located in DS-TT or NW-TT.

5GS shall support transfer of standardized and deployment-specific port management information transparently between TSN AF or NEF and DS-TT or NW-TT, respectively inside a Port Management Information Container. NW-TT may support one or more ports. In this case, each port uses separate Port Management Information Container. 5GS shall also support transfer of standardized and deployment-specific bridge management information transparently between TSN AF or NEF and NW-TT, respectively inside a Bridge Management Information Container. Table 5.28.3.1-1 and Table 5.28.3.1-2 list standardized port management information and bridge management information, respectively.

Table 5.28.3.1-1: Standardized port management information

|  |  |  |  |
| --- | --- | --- | --- |
| Port management information | Applicability (see NOTE 6) | Supported operations by TSN AF | Reference |
|  | DS-TT | NW-TT | (see NOTE 1) |  |
| **General** |  |  |  |  |
| Port management capabilities (see NOTE 2) | X | X | R |  |
| **Bridge delay related information** |  |  |  |  |
| txPropagationDelay | X | X | R | IEEE Std 802.1Qcc [95] clause 12.32.2.1 |
| **Traffic class related information** |  |  |  |  |
| Traffic class table | X | X | RW | IEEE Std 802.1Q [98] clause 12.6.3 and clause 8.6.6. |
| **Gate control information** |  |  |  |  |
| GateEnabled | X | X | RW | IEEE Std 802.1Q [98] Table 12-29 |
| AdminBaseTime | X | X | RW | IEEE Std 802.1Q [98] Table 12-29 |
| AdminControlList | X | X | RW | IEEE Std 802.1Q [98] Table 12-29 |
| AdminCycleTime (see NOTE 3) | X | X | RW | IEEE Std 802.1Q [98] Table 12-29 |
| AdminControlListLength (see NOTE 3) | X | X | RW | IEEE Std 802.1Q [98] Table 12-28 |
| Tick granularity | X | X | R | IEEE Std 802.1Q [98] Table 12-29 |
| **General Neighbor discovery configuration****(NOTE 4)** |  |  |  |  |
| adminStatus | D | X | RW | IEEE Std 802.1AB [97] clause 9.2.5.1 |
| lldpV2LocChassisIdSubtype | D | X | RW | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2LocChassisId | D | X | RW | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2MessageTxInterval | D | X | RW | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2MessageTxHoldMultiplier | D | X | RW | IEEE Std 802.1AB [97] Table 11-2 |
| **NW-TT port neighbor discovery configuration** |  |  |  |  |
| lldpV2LocPortIdSubtype |  | X | RW | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2LocPortId |  | X | RW | IEEE Std 802.1AB [97] Table 11-2 |
| **DS-TT port neighbor discovery configuration** |  |  |  |  |
| lldpV2LocPortIdSubtype | D |  | RW | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2LocPortId | D |  | RW | IEEE Std 802.1AB [97] Table 11-2 |
| **Neighbor discovery information for each discovered neighbor of NW-TT** |  |  |  |  |
| lldpV2RemChassisIdSubtype |  | X | R | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2RemChassisId |  | X | R | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2RemPortIdSubtype |  | X | R | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2RemPortId |  | X | R | IEEE Std 802.1AB [97] Table 11-2 |
| TTL |  | X | R | IEEE Std 802.1AB [97] clause 8.5.4 |
| **Neighbor discovery information for each discovered neighbor of DS-TT****(NOTE 5)** |  |  |  |  |
| lldpV2RemChassisIdSubtype | D |  | R | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2RemChassisId | D |  | R | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2RemPortIdSubtype | D |  | R | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2RemPortId | D |  | R | IEEE Std 802.1AB [97] Table 11-2 |
| TTL | D |  | R | IEEE Std 802.1AB [97] clause 8.5.4.1 |
| **Stream Parameters****(NOTE 11)** |  |  |  |  |
| MaxStreamFilterInstances | X |  | R | IEEE Std 802.1Q [98] clause 12.31.1.1 |
| MaxStreamGateInstances | X |  | R | IEEE Std 802.1Q [98] clause 12.31.1.2 |
| MaxFlowMeterInstances | X |  | R | IEEE Std 802.1Q [98] clause 12.31.1.3 |
| SupportedListMax | X |  | R | IEEE Std 802.1Q [98] clause 12.31.1.4 |
| **Per-Stream Filtering and Policing information**(NOTE 10) |  |  |  |  |
| Stream Filter Instance Table(NOTE 8) |  |  |  | IEEE Std 802.1Q [98] Table 12-32 |
| > Stream Identification type | X | X | RW | IEEE 802.1CB [83] clause 9.1.1.6 |
| > Stream Identification Controlling Parameters | X | X | RW | IEEE 802.1CB [83] clauses 9.1.2, 9.1.3, 9.1.4(NOTE 12) |
| > PrioritySpec | X | X | RW | IEEE Std 802.1Q [98] Table 12-32 |
| > StreamGateInstanceID | X | X | RW | IEEE Std 802.1Q [98] Table 12-32 |
| Stream Gate Instance Table(NOTE 9) |  |  |  | IEEE Std 802.1Q [98] Table 12-33 |
| StreamGateInstance | X | X | R | IEEE Std 802.1Q [98] Table 12-33 |
| PSFPAdminBaseTime | X | X | RW | IEEE Std 802.1Q [98] Table 12-33 |
| PSFPAdminControlList | X | X | RW | IEEE Std 802.1Q [98] Table 12-33 |
| PSFPAdminCycleTime | X | X | RW | IEEE Std 802.1Q [98] Table 12-33 |
| PSFPTickGranularity | X | X | R | IEEE Std 802.1Q [98] Table 12-33 |
| NOTE 1: R = Read only access; RW = Read/Write access.NOTE 2: Indicates which standardized and deployment-specific port management information is supported by DS-TT or NW-TT.NOTE 3: AdminCycleTime and AdminControlListLength are optional for gate control information.NOTE 4: If DS-TT supports neighbor discovery, then TSN AF sends the general neighbor discovery configuration for DS-TT Ethernet ports to DS-TT. If DS-TT does not support neighbor discovery, then TSN AF sends the general neighbor discovery configuration for DS-TT Ethernet ports to NW-TT using the Bridge Management Information Container (refer to Table 5.28.3.1-2) and NW-TT performs neighbor discovery on behalf on DS-TT. When a parameter in this group is changed, it is necessary to provide the change to every DS-TT and the NW-TT that belongs to the 5GS TSN bridge. It is mandatory that the general neighbor discovery configuration is identical for all DS-TTs and the NW-TTs that belongs to the bridge.NOTE 5: If DS-TT supports neighbor discovery, then TSN AF retrieves neighbor discovery information for DS-TT Ethernet ports from DS-TT. If DS-TT does not support neighbor discovery, then TSN AF retrieves neighbor discovery information for DS-TT Ethernet ports from NW-TT, using the Bridge Management Information Container (refer to Table 5.28.3.1-2), the NW-TT performing neighbor discovery on behalf on DS-TT.NOTE 6: X = applicable; D = applicable when validation and generation of LLDP frames is processed at the DS-TT.NOTE 7: Void.NOTE 8: There is a Stream Filter Instance Table per Stream.NOTE 9: There is a Stream Gate Instance Table per Gate.NOTE 10: TSN AF indicates the support for PSFP to the CNC only if each DS-TT and NW-TT of the 5GS bridge has indicated support of PSFP. DS-TT indicates support of PSFP using port management capabilities, i.e. by indicating support for the Per-Stream Filtering and Policing information and by setting higher than zero values for MaxStreamFilterInstances, MaxStreamGateInstances, MaxFlowMeterInstances, SupportedListMax parameters. When available, TSN AF uses the PSFP information for determination of the traffic pattern information as described in Annex I. The PSFP information can be used at the DS-TT (if supported) and at the NW-TT (if supported) for the purpose of per-stream filtering and policing as defined in IEEE Std 802.1Q [98] clause 8.6.5.1.NOTE 11: TSN AF composes a Stream Parameter Table towards the CNC. It is up to TSN AF how it composes the Stream Parameter Table based on the numerical values as received from DS-TT and NW-TT port(s) and for the bridge for each individual parameter.NOTE 12: The set of Stream Identification Controlling Parameters depends on the Stream Identification type value as defined in IEEE Std 802.1CB [83] Table 9-1 and clauses 9.1.2, 9.1.3, 9.1.4. |

Table 5.28.3.1-2: Standardized bridge management information

|  |  |  |
| --- | --- | --- |
| Bridge management information | Supported operations by TSN AF(see NOTE 1) | Reference |
| **Information for 5GS Bridge** |  |  |
| Bridge Address | R |  |
| Bridge ID | R |  |
| NW-TT port numbers | R |  |
| **Traffic forwarding information**  |  |  |
| Static Filtering Entry (NOTE 3) | RW | IEEE Std 802.1Q [98] clause 8.8.1 |
| **General Neighbor discovery configuration****(NOTE 2)** |  |  |
| adminStatus | RW | IEEE Std 802.1AB [97] clause 9.2.5.1 |
| lldpV2LocChassisIdSubtype | RW | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2LocChassisId | RW | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2MessageTxInterval | RW | IEEE Std 802.1AB [97] Table 11-2 |
| lldpV2MessageTxHoldMultiplier | RW | IEEE Std 802.1AB [97] Table 11-2 |
| **DS-TT port neighbor discovery configuration for DS-TT ports (NOTE 4)** |  |  |
| **>DS-TT port neighbor discovery configuration for each DS-TT port** |  |  |
| >> DS-TT port number | RW |  |
| >> lldpV2LocPortIdSubtype | RW | IEEE Std 802.1AB [97] Table 11-2 |
| >> lldpV2LocPortId | RW | IEEE Std 802.1AB [97] Table 11-2 |
| **Discovered neighbor information for DS-TT ports****(NOTE 4)** |  |  |
| **>Discovered neighbor information for each DS-TT port****(NOTE 4)** |  |  |
| >> DS-TT port number | R |  |
| >> lldpV2RemChassisIdSubtype | R | IEEE Std 802.1AB [97] Table 11-2 |
| >> lldpV2RemChassisId | R | IEEE Std 802.1AB [97] Table 11-2 |
| >> lldpV2RemPortIdSubtype | R | IEEE Std 802.1AB [97] Table 11-2 |
| >> lldpV2RemPortId | R | IEEE Std 802.1AB [97] Table 11-2 |
| >> TTL | R | IEEE Std 802.1AB [97] clause 8.5.4.1 |
| **Stream Parameters (NOTE 5)** |  |  |
| MaxStreamFilterInstances | R | IEEE Std 802.1Q [98] |
| MaxStreamGateInstances | R | IEEE Std 802.1Q [98] |
| MaxFlowMeterInstances | R | IEEE Std 802.1Q [98] |
| SupportedListMax | R | IEEE Std 802.1Q [98] |
| NOTE 1: R = Read only access; RW = Read/Write access.NOTE 2: General neighbor discovery information is included only when NW-TT performs neighbor discovery on behalf of DS-TT. When a parameter in this group is changed, it is necessary to provide the change to every DS-TT and the NW-TT that belongs to the 5GS TSN bridge.NOTE 3: If the Static Filtering Entry information is present, NW-TT uses Static Filtering Entry information to determine the NW-TT egress port for forwarding UL TSC traffic. If the Static Filtering Entry information is not present, then the forwarding information as in clause 5.8.2.5.3 applies. This release of the specification does not support Static Filtering Entries in the downlink direction.NOTE 4: DS-TT discovery configuration and DS-TT discovery information are used only when DS-TT does not support LLDP and NW-TT performs neighbor discovery on behalf of DS-TT.NOTE 5: TSN AF indicates the support for PSFP to the CNC only if each DS-TT and NW-TT of the 5GS bridge have indicated support of PSFP. The support of PSFP at the NW-TT ports is expressed by setting higher than zero values for MaxStreamFilterInstances, MaxStreamGateInstances, MaxFlowMeterInstances, SupportedListMax parameters. |

Exchange of port and bridge management information between TSN AF and NW-TT or DS-TT allows TSN AF to:

1) retrieve port management information for a DS-TT or NW-TT Ethernet port or bridge management information for a 5GS TSN bridge;

2) send port management information for a DS-TT or NW-TT Ethernet port or bridge management information for a 5GS TSN bridge;

3) subscribe to and receive notifications if specific port management information for a DS-TT or NW-TT Ethernet port changes or bridge management information changes.

Additionally, exchange of port and bridge management information between TSN AF or NEF and NW-TT or DS-TT allows TSN AF or NEF to:

1. retrieve port management information regarding gPTP or PTP operation capabilities for a DS-TT or NW-TT port;
2. send port management information including gPTP or PTP configuration for a DS-TT or NW-TT port;
3. subscribe to and receive notifications for BMCA reports if bridge management information changes for a NW-TT.

Exchange of port management information between TSN AF or NEF and NW-TT or DS-TT is initiated by DS-TT or NW-TT to:

- notify TSN AF or NEF if port management information has changed that TSN AF or NEF has subscribed for.

Exchange of bridge management information between TSN AF or NEF and NW-TT is initiated by NW-TT to:

- notify TSN AF or NEF if bridge management information has changed that TSN AF or NEF has subscribed for.

Exchange of port management information is initiated by DS-TT to:

- provide port management capabilities, i.e. provide information indicating which standardized and deployment-specific port management information is supported by DS-TT.

TSN AF or NEF indicates inside the Port Management Information Container or Bridge Management Information Container whether it wants to retrieve or send port or bridge management information or intends to (un-)subscribe for notifications.

#### 5.28.3.2 Transfer of port or bridge management information

Port management information is transferred transparently via 5GS between TSN AF or NEF and DS-TT or NW-TT, respectively, inside a Port Management Information Container (PMIC). Bridge management information is transferred transparently via 5GS between TSN AF or NEF and NW-TT inside a Bridge Management Information Container (BMIC). The transfer of port or bridge management information is as follows:

- To convey port management information from DS-TT or NW-TT to TSN AF or NEF:

- DS-TT provides a PMIC and the DS-TT port MAC address to the UE, which includes the PMIC as an optional Information Element of an N1 SM container and triggers the UE requested PDU Session Establishment procedure or PDU Session Modification procedure to forward the PMIC to the SMF. SMF forwards the PMIC and the port number of the related DS-TT Ethernet port to TSN AF as described in TS 23.502 [3] clause 4.3.3.2;

- NW-TT provides PMIC(s) and/or BMIC to the UPF, which triggers the N4 Session Level Reporting Procedure to forward the PMIC(s) and/or BMIC to SMF. UPF selects an N4 session corresponding to any of the N4 sessions for this NW-TT. SMF in turn forwards the PMIC(s) and the port number(s) of the related NW-TT Ethernet port(s), or the BMIC, to TSN AF as described in TS 23.502 [3] clause 4.16.5.1.

NOTE: There has to be at least one established PDU session for DS-TT port before the UPF can report PMIC/BMIC information towards the AF or NEF.

- To convey port management information from TSN AF or NEF to DS-TT:

- TSN AF or NEF provides a PMIC, MAC address reported for a PDU Session (i.e. MAC address of the DS-TT port related to the PDU session) and the port number of the Ethernet port to manage to the PCF by using the AF Session level Procedure, which forwards the information to SMF based on the MAC address using the PCF initiated SM Policy Association Modification procedure as described in TS 23.502 [3] clause 4.16.5.2. SMF determines that the port number relates to a DS-TT Ethernet port and based on this forwards the PMIC to DS-TT using the network requested PDU Session Modification procedure as described in TS 23.502 [3] clause 4.3.3.2.

- To convey port or bridge management information from TSN AF or NEF to NW-TT:

- TSN AF or NEF selects a PCF-AF session corresponding to any of the DS-TT MAC addresses for the related PDU sessions of this 5G TSN bridge or service Time Domain and provides a PMIC(s) and the related NW-TT port number(s) and/or BMIC to the PCF. The PCF uses the PCF initiated SM Policy Association Modification procedure to forward the information received from TSN AF of NEF to SMF as described in TS 23.502 [3] clause 4.16.5.2. SMF determines that the included information needs to be delivered to the NW-TT either by determining that the port number(s) relate(s) to a NW-TT Ethernet port(s) or based on the presence of BMIC, and forwards the container(s) and/or related port number(s) to NW-TT using the N4 Session Modification procedure described in TS 23.502 [3] clause 4.4.1.3.

---Start of the 6th Change---

### 6.2.5 NEF

#### 6.2.5.0 NEF functionality

The Network Exposure Function (NEF) supports the following independent functionality:

- Exposure of capabilities and events:

 NF capabilities and events may be securely exposed by NEF for e.g. 3rd party, Application Functions, Edge Computing as described in clause 5.13.

 NEF stores/retrieves information as structured data using a standardized interface (Nudr) to the Unified Data Repository (UDR).

- Secure provision of information from external application to 3GPP network:

 It provides a means for the Application Functions to securely provide information to 3GPP network, e.g. Expected UE Behaviour, 5G-VN group information, time synchronization service information, and service specific information. In that case the NEF may authenticate and authorize and assist in throttling the Application Functions.

- Translation of internal-external information:

 It translates between information exchanged with the AF and information exchanged with the internal network function. For example, it translates between an AF-Service-Identifier and internal 5G Core information such as DNN, S-NSSAI, as described in clause 5.6.7.

 In particular, NEF handles masking of network and user sensitive information to external AF's according to the network policy.

- The Network Exposure Function receives information from other network functions (based on exposed capabilities of other network functions). NEF stores the received information as structured data using a standardized interface to a Unified Data Repository (UDR). The stored information can be accessed and "re-exposed" by the NEF to other network functions and Application Functions, and used for other purposes such as analytics.

- A NEF may also support a PFD Function: The PFD Function in the NEF may store and retrieve PFD(s) in the UDR and shall provide PFD(s) to the SMF on the request of SMF (pull mode) or on the request of PFD management from NEF (push mode), as described in TS 23.503 [45].

- A NEF may also support a 5G-VN Group Management Function: The 5G-VN Group Management Function in the NEF may store the 5G-VN group information in the UDR via UDM as described in TS 23.502 [3].

- A NEF may also support determination of time synchronization service policy based on the information received from the AF and the capabilities indicated by 5GS network functions. The NEF may store the time synchronization service information in the UDR as described in TS 23.502 [3].

- Exposure of analytics:

 NWDAF analytics may be securely exposed by NEF for external party, as specified in TS 23.288 [86].

- Retrieval of data from external party by NWDAF:

 Data provided by the external party may be collected by NWDAF via NEF for analytics generation purpose. NEF handles and forwards requests and notifications between NWDAF and AF, as specified in TS 23.288 [86].

- Support of Non-IP Data Delivery:

 NEF provides a means for management of NIDD configuration and delivery of MO/MT unstructured data by exposing the NIDD APIs as described in TS 23.502 [3] on the N33/Nnef reference point. See clause 5.31.5.

A specific NEF instance may support one or more of the functionalities described above and consequently an individual NEF may support a subset of the APIs specified for capability exposure.

NOTE: The NEF can access the UDR located in the same PLMN as the NEF.

The services provided by the NEF are specified in clause 7.2.8.

The IP address(es)/port(s) of the NEF may be locally configured in the AF, or the AF may discover the FQDN or IP address(es)/port(s) of the NEF by performing a DNS query using the External Identifier of an individual UE or using the External Group Identifier of a group of UEs, or, if the AF is trusted by the operator, the AF may utilize the NRF to discover the FQDN or IP address(es)/port(s) of the NEF as described in clause 6.3.14.

For external exposure of services related to specific UE(s), the NEF resides in the HPLMN. Depending on operator agreements, the NEF in the HPLMN may have interface(s) with NF(s) in the VPLMN.

When a UE is capable of switching between EPC and 5GC, an SCEF+NEF is used for service exposure. See clause 5.17.5 for a description of the SCEF+NEF.

---End of Changes---