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Time-Sensitive Networking (TSN) Application Function (AF)
to Device-Side TSN Translator (DS-TT)
and Network-Side TSN Translator (NW-TT) protocol aspects;
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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

shall indicates a mandatory requirement to do something

shall not indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

can indicates that something is possible

cannot indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

will indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

will not indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

might indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

1 Scope

The present document specifies the protocols of communication between a DS-TT and a TSN AF or a NW-TT and a TSN AF as specified in 3GPP TS 23.501 [2] for:

a) Ethernet port management; and

b) Bridge management.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

[3] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[4] 3GPP TS 24.007: "Mobile radio interface signalling layer 3; General aspects".

[5] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".

[5A] 3GPP TS 29.244: "Interface between the Control Plane and the User Plane nodes".

[5B] 3GPP TS 29.512: "5G System; Session Management Policy Control Service; Stage 3".

[6] IEEE Std 802.1AB-2016: "IEEE Standard for Local and metropolitan area networks -- Station and Media Access Control Connectivity Discovery".

[7] IEEE Std 802.1Q-2018: "Standard for Local and metropolitan area networks--Bridges and Bridged Networks".

[8] Void

[9] IEEE Std 802.1Qcc-2018: "Standard for Local and metropolitan area networks - Bridges and Bridged Networks - Amendment: Stream Reservation Protocol (SRP) Enhancements and Performance Improvements".

[10] IEEE Std 802.1CB-2017: "IEEE Standard for Local and metropolitan area networks-Frame Replication and Elimination for Reliability".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

example: text used to clarify abstract rules by applying them literally.

Parameter-entry: entry of a port parameter or bridge management parameter data structure supporting instantiation. For example:

- Static filtering entry is a parameter-entry of Static filtering entries as specified in clause 9.6 referred by a combination of MacAddress value and VID value;
- Stream filter instance is a parameter-entry of Stream filter instance table as specified in clause 9.8 referred by DS-TT port number value;
- Stream gate instance is a parameter-entry of Stream gate instance table as specified in clause 9.9 referred by StreamGateInstance value; or
- DS-TT port neighbor discovery configuration for DS-TT ports instance is a parameter-entry of DS-TT port neighbor discovery configuration for DS-TT ports as specified in clause 9.10 referred by DS-TT port number value.

For the purposes of the present document, the following terms and definitions given in 3GPP TS 23.501 [2] apply:

5G System
Time Sensitive Communication

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

5GS	5G System
AF	Application function
BMS	Bridge Management Service
CNC	Centralized Network Configuration
DS-TT	Device-Side TSN Translator
EPMS	Ethernet port management service
NW-TT	Network-Side TSN Translator
TSC	Time Sensitive Communication
TSN	Time-Sensitive Networking

4 General

For time sensitive communication (TSC), a 5G system (5GS) can be integrated as a bridge in a time-sensitive networking (TSN) network (i.e. a TSN bridge).

The device-side TSN translator (DS-TT) is deployed at the UE-side edge and the network-side TSN translator (NW-TT) is deployed at the network-side edge in order to interface with a TSN network while achieving transparency (see 3GPP TS 23.501 [2]). In addition, the TSN application function (TSN AF) is deployed to exchange TSN bridge information with the centralized network configuration (CNC) as defined in IEEE Std 802.1Qcc-2018 [9]. The TSN bridge information includes port management information and bridge management information. Port management information is related to Ethernet ports located in the DS-TT and NW-TT. Bridge management information is related to the NW-TT.

In order to support TSN bridge information exchange between TSN AF and CNC, the DS-TT, NW-TT, and TSN AF support procedures for Ethernet port management and Bridge management. Clause 5 describes details of the elementary procedures between TSN AF and DS-TT for Ethernet port management. Clause 6 describes details of the elementary procedures between TSN AF and NW-TT for Ethernet port management (clause 6.2) and Bridge management (clause 6.3).

5 Elementary procedures between TSN AF and DS-TT

5.1 General

The UE and the network may support transfer of standardized and deployment-specific Ethernet port management information between a time-sensitive networking (TSN) AF and the DS-TT at the UE, to manage the Ethernet port used at the DS-TT for a PDU session of "Ethernet" PDU session type. The Ethernet port management messages are included in a Port management information container IE and transported using the UE-requested PDU session establishment procedure, the network-requested PDU session modification procedure or the UE-requested PDU session modification procedure as specified in 3GPP TS 24.501 [5] clauses 6.4.1.2, 6.3.2 and 6.4.2.

5.2 Procedures

5.2.1 Network-requested Ethernet port management procedure

5.2.1.1 General

The purpose of the network-requested Ethernet port management procedure is to enable the TSN AF to:

a) obtain the list of port management parameters supported by the DS-TT;

b) obtain the current values of port management parameters at the DS-TT Ethernet port;

c) set the values of port management parameters at the DS-TT Ethernet port;

d) subscribe to be notified by the DS-TT if the values of certain port management parameters change at the DS-TT Ethernet port;

e) unsubscribe to be notified by the DS-TT for one or more port management parameters; or

f) delete a port management parameter-entry at the DS-TT Ethernet port.

5.2.1.2 Network-requested Ethernet port management procedure initiation

In order to initiate the network-requested Ethernet port management procedure, the TSN AF shall:

a) encode the information about the port management parameters values to be read, the port management parameters values to be set, the port management parameters changes to (un)subscribe to, the port management parameter-entry to be deleted and whether the TSN AF requests the list of port management parameters supported by the DS-TT in an Ethernet port management list IE as specified in clause 9.2 and include it in a MANAGE ETHERNET PORT COMMAND message;

c) send the MANAGE ETHERNET PORT COMMAND message to the UE via the PCF and the SMF as specified in 3GPP TS 23.502 [3]; and

d) start timer T100 (see example in figure 5.2.1.2.1).

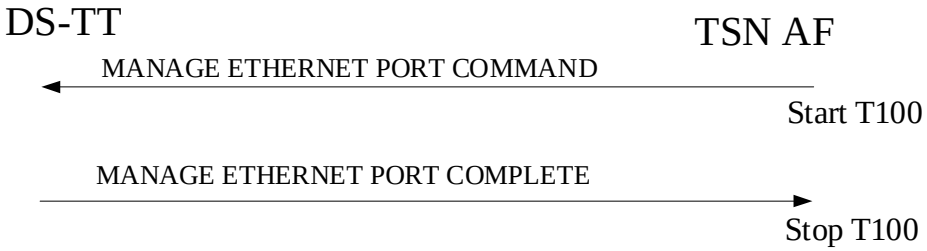

Figure 5.2.1.2.1: Network-requested Ethernet port management procedure

5.2.1.3 Network-requested Ethernet port management procedure completion

Upon receipt of the MANAGE ETHERNET PORT COMMAND message, for each operation included in the Ethernet port management list IE, the DS-TT shall:

a) if the operation code is "get capabilities", include the list of Ethernet port management parameters supported by the DS-TT in the Ethernet port management capability IE of the MANAGE ETHERNET PORT COMPLETE message;

b) if the operation code is "read parameter", attempt to read the value of the parameter at the DS-TT Ethernet port, and:

   1) if the value of the parameter at the DS-TT Ethernet port is read successfully, include the parameter and its current value in the Ethernet port status IE of the MANAGE ETHERNET PORT COMPLETE message; and

   2) if the value of the parameter at the DS-TT Ethernet port was not read successfully, include the parameter and associated Ethernet port management service cause value in the Ethernet port status IE of the MANAGE ETHERNET PORT COMPLETE message;

c) if the operation code is "set parameter", attempt to set the value of the parameter at the DS-TT Ethernet port to the value specified in the operation, and:

   1) if the value of the parameter at the DS-TT Ethernet port is set successfully, include the parameter and its current value in the Ethernet port update result IE of the MANAGE ETHERNET PORT COMPLETE message; and

   2) if the value of the parameter at the DS-TT Ethernet port was not set successfully, include the parameter and associated Ethernet port management service cause value in the Ethernet port update result IE of the MANAGE ETHERNET PORT COMPLETE message;

d) if the operation code is "subscribe-notify for parameter", store the request from the TSN AF to be notified of changes in the value of the corresponding parameter;

e) if the operation code is "unsubscribe for parameter", delete the stored request from the TSN AF to be notified of changes in the value of the corresponding parameter, if any;

f) if the operation code is "delete parameter-entry", attempt to delete the referred parameter-entry of the parameter at the DS-TT Ethernet port; and

   1) if the parameter-entry of the parameter at the DS-TT Ethernet port is deleted successfully, include the parameter and its current value in the Ethernet port update result IE of the MANAGE ETHERNET PORT COMPLETE message; and

   2) if the parameter-entry of the parameter at the DS-TT Ethernet port was not deleted successfully, include the parameter and associated Ethernet port management service cause value in the Ethernet port update result IE of the MANAGE ETHERNET PORT COMPLETE message; and

g) send the MANAGE ETHERNET PORT COMPLETE to the TSN AF via the SMF and the PCF as specified in 3GPP TS 23.502 [3].

5.2.1.4 Abnormal cases on the network side

The following abnormal cases can be identified:

a) T100 expired.

   The TSN AF shall, on the first expiry of the timer T100, retransmit the MANAGE ETHERNET PORT COMMAND message and shall reset and start timer T100. This retransmission is repeated four times, i.e. on the fifth expiry of timer T100, the TSN AF shall abort the procedure.

5.2.1.5 Abnormal cases in the DS-TT

The following abnormal cases can be identified:

a) Transmission failure of the MANAGE ETHERNET PORT COMPLETE message indication from lower layers.

The DS-TT shall not diagnose an error and consider the network-initiated Ethernet port management procedure complete.

NOTE: Considering the network-initiated Ethernet port management procedure complete as a result of this abnormal case does not cause the DS-TT to revert the execution of the operations included in the MANAGE ETHERNET PORT COMMAND message.

5.2.2 DS-TT-initiated Ethernet port management procedure

5.2.2.1 General

The purpose of the DS-TT-initiated Ethernet port management procedure is to notify the TSN AF of one or more changes in the value of Ethernet port management parameters for which the TSN AF had requested to be notified of changes via the network-initiated Ethernet port management procedure.

5.2.2.2 DS-TT-initiated Ethernet port management procedure initiation

In order to initiate the DS-TT-initiated Ethernet port management procedure, the DS-TT shall create an ETHERNET PORT MANAGEMENT NOTIFY message and shall:

a) include the Ethernet port management parameters to be reported to the TSN AF with their current value in the Ethernet port status IE of the ETHERNET PORT MANAGEMENT NOTIFY message;

b) start timer T200; and

c) send the ETHERNET PORT MANAGEMENT NOTIFY message to the TSN AF via the SMF and the PCF as specified in 3GPP TS 23.502 [3].

Figure 5.2.2.2.1: DS-TT-initiated Ethernet port management procedure

5.2.2.3 DS-TT-initiated Ethernet port management procedure accepted by the TSN AF

Upon receipt of the ETHERNET PORT MANAGEMENT NOTIFY message, the TSN AF shall:

a) create a MANAGE ETHERNET PORT MANAGEMENT NOTIFY ACK message; and

b) send the MANAGE ETHERNET PORT MANAGEMENT NOTIFY ACK message to the UE via the PCF and the SMF as specified in 3GPP TS 23.502 [3].

5.2.2.4 DS-TT-initiated Ethernet port management procedure completion

Upon receipt of the ETHERNET PORT MANAGEMENT NOTIFY ACK message, the DS-TT shall:

a) stop timer T200;

b) create an ETHERNET PORT MANAGEMENT NOTIFY COMPLETE message; and

c) send the ETHERNET PORT MANAGEMENT NOTIFY COMPLETE message to the TSN AF via the SMF and the PCF as specified in 3GPP TS 23.502 [3].

5.2.2.5 Abnormal cases on the network side

The following abnormal cases can be identified:

a) Transmission failure of the ETHERNET PORT MANAGEMENT NOTIFY ACK indication from lower layers.

The TSN AF shall not diagnose an error and consider the DS-TT-initiated Ethernet port management procedure complete.

5.2.2.6 Abnormal cases in the DS-TT

The following abnormal cases can be identified:

a) T200 expired.

The DS-TT shall, on the first expiry of the timer T200, retransmit the ETHERNET PORT MANAGEMENT NOTIFY message and shall reset and start timer T200. This retransmission is repeated four times, i.e. on the fifth expiry of timer T200, the DS-TT shall abort the procedure.

b) Transmission failure of the ETHERNET PORT MANAGEMENT NOTIFY COMPLETE message indication from lower layers.

The DS-TT shall not diagnose an error and consider the DS-TT-initiated Ethernet port management procedure complete.

5.2.3 DS-TT-initiated Ethernet port management capability procedure

5.2.3.1 General

The purpose of the DS-TT-initiated Ethernet port management capability procedure is to provide the DS-TT supported Ethernet port management capabilities to the TSN AF during PDU session establishment as specified in 3GPP TS 23.502 [3].

5.2.3.2 DS-TT-initiated Ethernet port management capability procedure

In order to initiate the DS-TT-initiated Ethernet port management capability procedure, the DS-TT shall create an ETHERNET PORT MANAGEMENT CAPABILITY message and shall:

a) include the DS-TT Ethernet port management capabilities in the Ethernet port management capability IE of the ETHERNET PORT MANAGEMENT CAPABILITY message; and

b) send the ETHERNET PORT MANAGEMENT CAPABILITY message to the TSN AF via the SMF and the PCF as specified in 3GPP TS 23.502 [3].

Figure 5.2.3.2.1: DS-TT-initiated Ethernet port management capability procedure

6 Elementary procedures between TSN AF and NW-TT

6.1 General

The TSN AF and NW-TT supports transfer of standardized and deployment-specific Ethernet port management information, to manage the Ethernet port used at the NW-TT. The TSN AF and NW-TT supports transfer of standardized and deployment-specific Bridge management information, to manage the NW-TT. The Ethernet port management messages are included in the "PortManagementContainer" data type (as specified in 3GPP TS 29.512 [5B]) and the Port Management Information Container IE (as specified in 3GPP TS 29.244 [5A]) and the Bridge management messages are included in the "BridgeManagementContainer" data type (as specified in 3GPP TS 29.512 [5B]) and the Bridge Management Information Container IE (as specified in 3GPP TS 29.244 [5A]). Both the Ethernet port management messages and the Bridge management messages are transported using the N4 Session Level Reporting Procedure and the SM policy association modification procedure as specified in 3GPP TS 23.502 [3].

6.2 Procedures for Ethernet port management service

6.2.1 TSN AF-requested Ethernet port management procedure

6.2.1.1 General

The purpose of the TSN AF-requested Ethernet port management procedure is to enable the TSN AF to:

a) obtain the list of port management parameters supported by the NW-TT;

b) obtain the current values of port management parameters at the NW-TT Ethernet port;

c) set the values of port management parameters at the NW-TT Ethernet port; or

d) subscribe to be notified by the NW-TT if the values of certain port management parameters change at the NW-TT Ethernet port;

e) unsubscribe to be notified by the NW-TT for one or more port management parameters; or

f) delete a port management parameter-entry at the NW-TT Ethernet port.

6.2.1.2 TSN AF-requested Ethernet port management procedure initiation

In order to initiate the TSN AF-requested Ethernet port management procedure, the TSN AF shall:

a) encode the information about the port management parameters values to be read, the port management parameters values to be set, the port management parameters changes to (un)subscribe to, the port management parameter-entry to be deleted and whether the TSN AF requests the list of port management parameters supported by the NW-TT in an Ethernet port management list IE as specified in clause 9.2 and include it in a MANAGE ETHERNET PORT COMMAND message;

b) send the MANAGE ETHERNET PORT COMMAND message to the NW-TT via the PCF and the SMF as specified in 3GPP TS 23.502 [3]; and

c) start timer T100 (see example in figure 6.2.1.2.1).