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TECHNICAL SPECIFICATION

5G;
5G System (5GS);
Device-Side Time Sensitive Networking (TSN)
Translator (DS-TT) to Network-Side TSN Translator (NW-TT)
protocol aspects;
Stage 3
(3GPP TS 24.535 version 17.2.0 Release 17)

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In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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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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where:

x   the first digit:

1   presented to TSG for information;

2   presented to TSG for approval;

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, certain modal verbs have the following meanings:

shall   indicates a mandatory requirement to do something

shall not   indicates an interdiction (prohibition) to do something

NOTE 1: The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

NOTE 2: 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

NOTE 3: 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

NOTE 4: The constructions "can" and "cannot" shall not to be used as 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

NOTE 5: The constructions "is" and "is not" do not indicate requirements.

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1 Scope

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

a) (g)PTP message delivery.

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] IEEE Std 1588-2019: "IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems".

[4] IEEE Std 802.1AS-2020: "IEEE Standard for Local and metropolitan area networks--Timing and Synchronization for Time-Sensitive Applications".

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.

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
TSN working domain

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
DS-TT	Device-Side TSN Translator
gPTP	Generalized Precision Time Protocol
NW-TT	Network-Side TSN Translator
OUI	Organizational Unique Identifier
PTP	Precision Time Protocol

TSC	Time Sensitive Communication
TSN	Time Sensitive Networking
TT	TSN Translator

4 General

For time synchronization and time sensitive communication (TSC), 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 (see 3GPP TS 23.501 [2]).

The DS-TT and NW-TT fulfil all functions related to IEEE Std 802.1AS [4] or IEEE Std 1588-2019 [3], which include delivery of (g)PTP messages. Clause 5 describes details of the (g)PTP message delivery.

5 (g)PTP message delivery

5.1 Overview

For time synchronization, a 5G system (5GS) can be configured to operate in one of the following modes (3GPP TS 23.501 [2]):

a) a time-aware system, for which the 5GS needs to support implementation of (g)PTP requirements (see IEEE Std 802.1AS [4]);

b) a boundary clock, for which the 5GS needs to support implementation of PTP requirements (see IEEE Std 1588-2019 [3];

c) a peer-to-peer transparent clock, for which the 5GS needs to support implementation of PTP requirements (see IEEE Std 1588-2019 [3]; and

d) an end-to-end transparent clock, for which the 5GS needs to support implementation of PTP requirements (see IEEE Std 1588-2019 [3].

Within a 5GS, a (g)PTP message is delivered over the user plane. While the generic mechanisms for the (g)PTP message delivery are according to IEEE Std 802.1AS [4] and IEEE Std 1588-2019 [3], a specific requirement for the DS-TT and the NW-TT is available in terms of the signalling of ingress time. See clause 5.2 for further details.

5.2 Signalling of ingress time for time synchronization and delay measurements

3GPP TS 23.501 [2] describes how to convey an ingress timestamp (TSi) for a (g)PTP event message, where the ingress TT creates a Suffix field with TSi encoded as specified in clause 5.3.1.

For a gPTP message, if the ingress TT is:

a) a NW-TT, support for these operations by the NW-TT is mandatory; or

b) a DS-TT, support for these operations by the DS-TT is optional.

For a PTP message, if the ingress TT is:

a) a NW-TT, support for these operations by the NW-TT is optional; or

b) a DS-TT, support for these operations by the DS-TT is optional.

The DS-TT or NW-TT (i.e. egress TT) creates an egress timestamping (TSe) for every (g)PTP event message. The egress TT uses TSi from the Suffix field of the (g)PTP message to calculate the residence time as specified in 3GPP TS 23.501 [2].

For a gPTP message, if the egress TT is:

    a) a NW-TT, support for these operations by the NW-TT is optional; or

    b) a DS-TT, support for these operations by the DS-TT is mandatory.

For a PTP message, if the egress TT is:

    a) a NW-TT, support for these operations by the NW-TT is optional; or

    b) a DS-TT, support for these operations by the DS-TT is optional.

5.3 Encoding of organization specific TLV extensions

5.3.1 General

Organization specific TLV extensions are included the Suffix field of a (g)PTP message as specified in clause 14.3 of IEEE Std 1588-2019 [3]. The Suffix field is coded as shown in figure 5.3.1.1 and table 5.3.1.1.
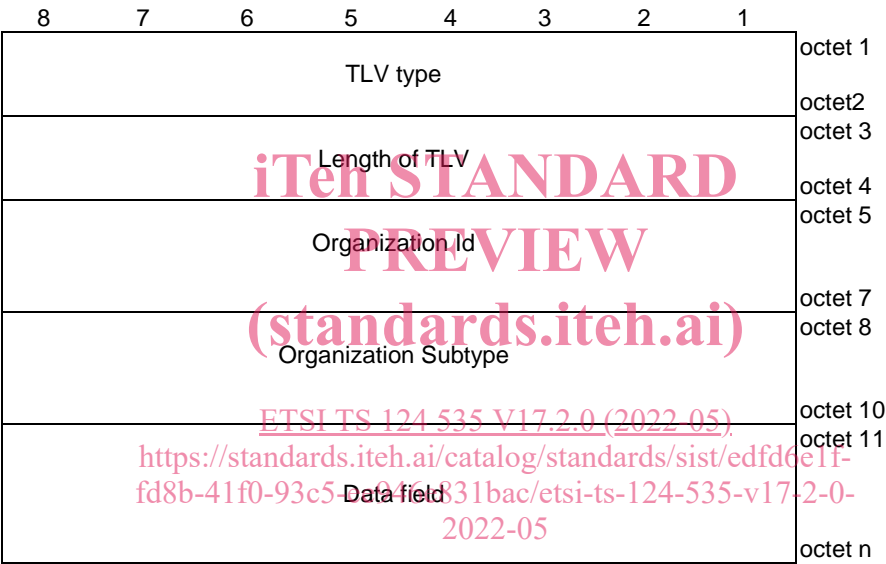

Figure 5.3.1.1: Suffix field

Table 5.3.1.1: Suffix field

TLV type (octets 1 to 2)

This field indicates the type of TLV extension and shall be coded as follows:

- 00003H ORGANIZATION_EXTENSION;

All other values are reserved.

Length of TLV (octets 3 to 4)

This field indicates the length of the value part of the TLV extension (i.e. octets 5 to n) coded in binary over 2 octets.

Organization Id (octets 5 to 7)

This field indicates the value of the Organizational Unique Identifier (OUI) assigned to 3GPP by the IEEE, coded in binary over 3 octets.

Organization Subtype (octets 8 to 10)

This field identifies the type of TLV extension included in the Data field and shall be coded as follows:

- 00000H Reserved;
- 00001H Ingress timestamp

All other values are spare.

Data field (octets 11 to n)

This field contains the contents of the specific TLV extension. Its encoding is specified in the corresponding clause.

Editor's note: The value of the OUI for 3GPP needs to be assigned by the IEEE.

5.3.2 Ingress timestamp

The Data field of a TLV extension carrying an Ingress timestamp is coded as shown in figure 5.3.2.1 and table 5.3.2.1.
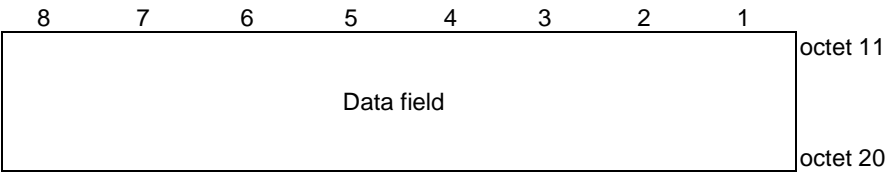
8	7	6	5	4	3	2	1	
								octet 11
			Data field					
								octet 20

Figure 5.3.2.1: Data field for Ingress timestamp (Organization Subtype = 0001H)

Table 5.3.2.1: Data field for Ingress timestamp (Organization Subtype = 0001H)

Data field (octets 11 to 20)

For Organization Subtype = 0001H, the data field contains the ingress timestamp of the (g)PTP event (Sync) message, encoded over 10 octets as specified in clause 5.3.3. of IEEE Std 1588-2019 [3].