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| 3GPP TS 24.535 V18.0.0 (2024-04) |
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| Technical Specification |
| 3rd Generation Partnership Project;Technical Specification Group Core Network and Terminals;5G System (5GS);Device-Side Time Sensitive Networking (TSN) Translator (DS-TT) to Network-Side TSN Translator (NW-TT) protocol aspects;Stage 3(Release 18) |
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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:

Version x.y.z

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.

# 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.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| TLV type | octet 1octet2 |
| Length of TLV | octet 3octet 4 |
| Organization Id | octet 5octet 7 |
| Organization Subtype | octet 8octet 10 |
| Data field | octet 11octet n |

Figure 5.3.1.1: Suffix field

Table 5.3.1.1: Suffix field

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| --- |
| 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 |  |
| Data field | octet 11octet 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)

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| --- |
| 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]. |
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Annex A (informative):
Change history

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| **Change history** |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2019-08 | CT1#119 | C1-194647 |  |  |  | Draft skeleton provided by the rapporteur | 0.0.0 |
| 2019-09 | CT1#119CT#85 | C1-194650CP-192258 |  |  |  | Implementation of an agreed pseudo CR (C1-194650)Addition of the TS number assigned in CT#85 | 0.1.0 |
| 2019-11 | CT1#121 |  |  |  |  | Implementation of the following pseudo CRs agreed by CT1:C1-198476, C1-198749, C1-198750, and C1-199023Corrections made by the rapporteur | 0.2.0 |
| 2019-12 | CT#86 | CP-193151 |  |  |  | Presentation for information to TSG CT | 1.0.0 |
| 2019-12 | CT#86 | CP-183288 |  |  |  | A title corrected | 1.0.1 |
| 2020-03 | CT1#122 |  |  |  |  | Implementation of the following pseudo CR agree by CT1:C1-200734Corrections made by the rapporteur | 1.1.0 |
| 2020-03 | CT-87e | CP-200167 |  |  |  | Presentation for approval to TSG CT | 2.0.0 |
| 2020-03 | CT-87e |  |  |  |  | Version 16.0.0 created after approval | 16.0.0 |
| 2020-06 | CT-88e | CP-201137 | 0002 | 1 | F | TSN working domain | 16.1.0 |
| 2020-09 | CT-89e | CP-202170 | 0003 |  | D | Editorial correction | 16.2.0 |
| 2020-12 | CT-90e | CP-203219 | 0004 | 1 | F | Update handling of suffix field | 16.3.0 |
| 2020-12 | CT-90e | CP-203219 | 0006 | 1 | F | TSi handling when the NW-TT generates the gPTP event messages | 16.3.0 |
| 2021-06 | CT-92e | CP-211136 | 0007 | 2 | B | Support for PTP message delivery | 17.0.0 |
| 2021-09 | CT-93e | CP-212134 | 0008 | 1 | C | Correction of timestamping the messages for time synchronization and delay measurements | 17.1.0 |
| 2021-12 | CT-94e | CP-213035 | 0009 |  | C | Removing unnecessary text in clause 5.2 | 17.2.0 |
| 2024-04 | - | - | - | - | - | Update to Rel-18 version (MCC) | **18.0.0** |