

ETSI TS 124 535 V16.4.0 (2026-07)



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 16.4.0 Release 16)**



Reference

RTS/TSGC-0124535vg40

Keywords

5G

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from the
[ETSI Search & Browse Standards](#) application.

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format on [ETSI deliver](#) repository.

Users should be aware that the present document may be revised or have its status changed, this information is available in the [Milestones listing](#).

If you find errors in the present document, please send your comments to the relevant service listed under [Committee Support Staff](#).

If you find a security vulnerability in the present document, please report it through our [Coordinated Vulnerability Disclosure \(CVD\)](#) program.

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

Copyright Notification

No part of this document may be reproduced in any form, by any means and in any media, without the prior written authorization of ETSI and except as expressly permitted below.

By way of exception and when the document is a normative deliverable (European Standard (EN), Technical Specification (TS), Group Specification (GS) or ETSI Standard (ES)), ETSI authorizes to reproduce and incorporate into products, services and technical documentation only those extracts (e.g. templates) that are strictly necessary for the technical implementation of the normative deliverable, to ensure compliance with the latter. Nothing in this notice shall be construed as limiting any mandatory exceptions to copyright provided by applicable law.

© ETSI 2026.
All rights reserved.

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables (European Standard (EN), Technical Specification (TS), Group Specification (GS) or ETSI Standard (ES)) may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the [ETSI IPR online database](#).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™**, **LTE™** and **5G™** logo are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

Legal Notice

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

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found at [3GPP to ETSI numbering cross-referencing](#).

Modal verbs terminology

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).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Intellectual Property Rights	2
Legal Notice	2
Modal verbs terminology.....	2
Foreword.....	4
1 Scope	6
2 References	6
3 Definitions of terms, symbols and abbreviations	6
3.1 Terms.....	6
3.2 Abbreviations	6
4 General	7
5 gPTP message delivery	7
5.1 Overview	7
5.2 Signalling of ingress time for time synchronization.....	7
5.3 Encoding of organization specific TLV extensions.....	7
5.3.1 General.....	7
5.3.2 Ingress timestamp	8
Annex A (informative): Change history	10
History	11

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) gPTP 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 1588-2008: "IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control".
- [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
TSC	Time Sensitive Communication

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]).

The DS-TT and NW-TT fulfil all functions related to IEEE 802.1AS [4], which include delivery of generalized precision time protocol (gPTP) messages. Clause 5 describes details of the gPTP message delivery.

5 gPTP message delivery

5.1 Overview

For TSN time synchronization, a 5G system (5GS) can be considered as a time-aware system, which needs to support implementation of generalized precision time protocol (gPTP) requirements (see IEEE 802.1AS [4]).

Within a 5GS, a gPTP message is delivered over the user plane. While the generic mechanisms for the gPTP message delivery are according to IEEE Std 802.1AS [4], 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

Upon reception of a downlink gPTP message (Sync message for one-step operation or Follow_Up message for two-step operation) for a given TSN working domain, the NW-TT shall create an ingress timestamping (TSi) for each gPTP event (Sync) message and add Suffix field with TSi to the gPTP message encoded as specified in clause 5.3.1.

Upon reception of a gPTP message over the user plane, the UE shall forward the gPTP message to the DS-TT. The DS-TT shall create an egress timestamping (TSe) for every gPTP event (Sync) message. The DS-TT shall use TSi from the Suffix field of the gPTP message (Sync message for one-step operation or Follow_Up message for two-step operation) to calculate the residence time spent within the 5G system for the gPTP event (Sync) message expressed in 5GS time as specified in 3GPP TS 23.501 [2] for the corresponding TSN working domain, then shall remove the Suffix field that contains TSi from the gPTP message before sending the gPTP message toward the downstream TSN node.

In case of multiple TSN working domains, the procedure above is repeated for each TSN working domain sending its own gPTP messages.

In case of a gPTP message (Sync message for one-step operation or Follow_Up message for two-step operation) locally generated by the NW-TT (i.e. synchronization is provided by the 5G clock), the NW-TT makes the time generating the gPTP event (Sync) message as TSi and add Suffix field with TSi to the gPTP message encoded as specified in clause 5.3.1.

5.3 Encoding of organization specific TLV extensions

5.3.1 General

Organization specific TLV extensions are included the Suffix field of a gPTP message as specified in clause 14.3 of IEEE Std 1588-2008 [3]. The Suffix field is coded as shown in figure 5.3.1.1 and table 5.3.1.1.

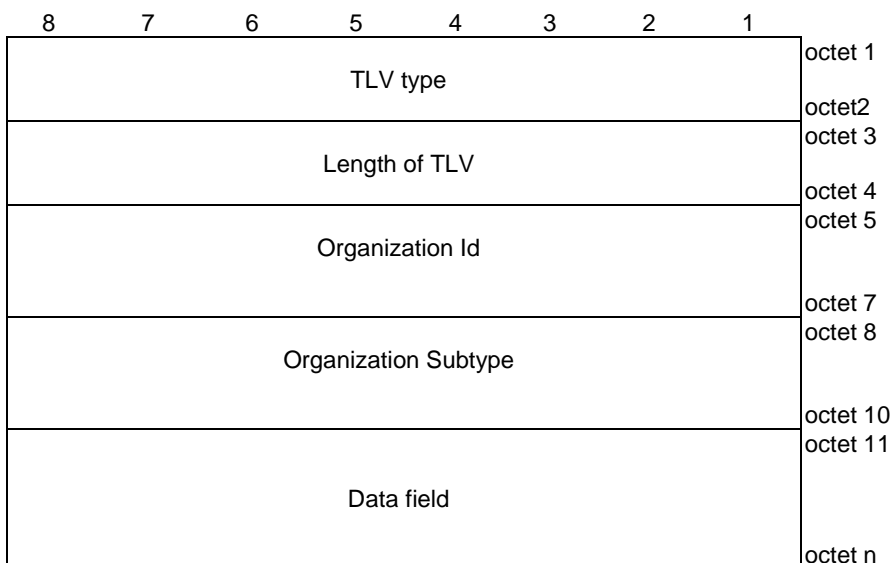


Figure 5.3.1.1: Suffix field

Table 5.3.1.1: Suffix field

<p>TLV type (octets 1 to 2)</p> <p>This field indicates the type of TLV extension and shall be coded as follows:</p> <ul style="list-style-type: none"> - 00003H ORGANIZATION_EXTENSION; <p>All other values are reserved.</p> <p>Length of TLV (octets 3 to 4)</p> <p>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.</p> <p>Organization Id (octets 5 to 7)</p> <p>This field indicates the value of the Company ID (CID) assigned to 3GPP by the IEEE, coded in binary over 3 octets.</p> <p>Organization Subtype (octets 8 to 10)</p> <p>This field identifies the type of TLV extension included in the Data field and shall be coded as follows:</p> <ul style="list-style-type: none"> - 00000H Reserved; - 00001H Ingress timestamp <p>All other values are spare.</p> <p>Data field (octets 11 to n)</p> <p>This field contains the contents of the specific TLV extension. Its encoding is specified in the corresponding clause.</p>

Editor's note: The value of the CID 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.

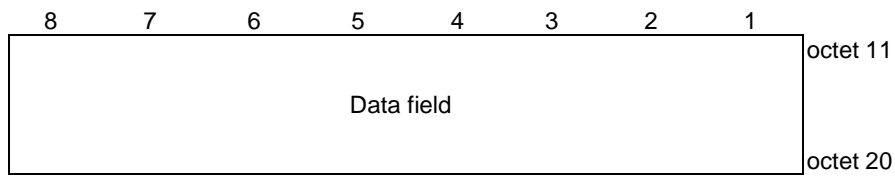


Figure 5.3.2.1: Data field for Ingress timestamp (Organization Subtype = 0001H)

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 gPTP event (Sync) message, encoded over 10 octets as specified in clause 5.3.3. of IEEE 1588-2008 [3].

Annex A (informative): Change history

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#119 CT#85	C1-194650 CP-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 C1-199023 Corrections 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: C1-200734 Corrections 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
2026-06	CT#112	CP-261093	0010		F	Replace OUI with CID	16.4.0

History

Version	Date	Status
V16.1.0	July 2020	Publication
V16.2.0	November 2020	Publication
V16.3.0	January 2021	Publication
V16.4.0	July 2026	Publication