

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.8271.2/Y.1366.2

Amendment 1
(03/2018)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
DIGITAL SYSTEMS AND NETWORKS

Packet over Transport aspects – Synchronization, quality
and availability targets

SERIES Y: GLOBAL INFORMATION
INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS,
NEXT-GENERATION NETWORKS, INTERNET OF
THINGS AND SMART CITIES

Internet protocol aspects – Transport

Network limits for time synchronization in packet
networks with partial timing support from the
network

Amendment 1

Recommendation ITU-T G.8271.2/Y.1366.2 (2017) –
Amendment 1



International
Telecommunication
Union

Document Sharing Hub

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TRANSMISSION MEDIA AND OPTICAL SYSTEMS CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
MULTIMEDIA QUALITY OF SERVICE AND PERFORMANCE – GENERIC AND USER-RELATED ASPECTS	G.1000–G.1999
TRANSMISSION MEDIA CHARACTERISTICS	G.6000–G.6999
DATA OVER TRANSPORT – GENERIC ASPECTS	G.7000–G.7999
PACKET OVER TRANSPORT ASPECTS	G.8000–G.8999
Ethernet over Transport aspects	G.8000–G.8099
MPLS over Transport aspects	G.8100–G.8199
Synchronization, quality and availability targets	G.8200–G.8299
Service Management	G.8600–G.8699
ACCESS NETWORKS	G.9000–G.9999

For further details, please refer to the list of ITU-T Recommendations.



Recommendation ITU-T G.8271.2/Y.1366.2

Network limits for time synchronization in packet networks with partial timing support from the network

Amendment 1

Summary

Recommendation ITU-T G.8271.2/Y.1366.2 specifies the maximum network limits of phase and time error that shall not be exceeded. It specifies the minimum equipment tolerance to phase and time error that shall be provided at the boundary of these packet networks at phase and time synchronization interfaces. It also outlines the minimum requirements for the synchronization function of network elements.

Recommendation ITU-T G.8271.2/Y.1366.2 addresses the case of time and phase distribution across a network with packet-based method with partial timing support to the protocol level from the network.

Amendment 1 provides the following updates:

- Addition of new acronyms
- Addition of note to clause 7
- Revision of sub-clause 7.3
- Addition of sub-clause 7.4
- Revision of Appendix I
- Revision of Appendix II

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G.8271.2/Y.1366.2	2017-08-13	15	11.1002/1000/13324
1.1	ITU-T G.8271.2/Y.1366.2 (2017) Amd. 1	2018-03-16	15	11.1002/1000/13551

Keywords

Network limits, partial timing support, phase, precision time protocol, synchronization, time.

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

© ITU 2018

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

Table of Contents

		Page
1	Scope.....	1
2	References.....	2
3	Definitions	3
4	Abbreviations and acronyms	3
5	Conventions	3
6	Network reference model	4
7	Packet network limits	4
7.1	Network limits at reference point A and A'	4
7.2	Network limit at reference point B	5
7.3	Network limits at reference point C	5
7.4	Network limit at reference point D.....	7
	Appendix I – Deployment scenarios for partial timing support networks.....	8
I.1	Assisted partial and partial timing support network use cases	8
I.2	Full timing support network followed by an assisted partial timing support network or partial timing support network.....	9
I.3	Partial timing support network followed by a full timing support network...	10
I.4	Assisted partial timing support network followed by a partial timing support network	10
I.5	Use of partial timing support network to bridge between two full timing support networks	10
I.6	Assisted partial timing support network followed by a full timing support network	10
	Appendix II – Considerations for handling precision time protocol traffic in networks with partial timing support.....	15
II.1	Network aspects.....	15
II.2	Time error performance aspects	16
	Appendix III – The use of frequency to maintain precise time	17
	Bibliography.....	19

Recommendation ITU-T G.8271.2/Y.1366.2

Network limits for time synchronization in packet networks with partial timing support from the network

Amendment 1

Editorial note: This is a complete-text publication. Modifications introduced by this amendment are shown in revision marks relative to Recommendation ITU-T G.8271.2/Y.1366.2 (2017).

1 Scope

This Recommendation specifies the maximum network limits of phase and time error that shall not be exceeded. It specifies the minimum equipment tolerance to phase and time error that shall be provided at the boundary of these packet networks at phase and time synchronization interfaces. It also outlines the minimum requirements for the synchronization function of network elements.

This Recommendation addresses the distribution of time and phase across a network, using the packet-based method with partial timing support to the protocol level from the network. In particular, it applies to the assisted partial timing support (APTS) and partial timing support (PTS) architectures described in [ITU-T G.8275] and the precision time protocol (PTP) profile defined in [ITU-T G.8275.2].

This Recommendation addresses the following cases.

1) Assisted partial timing support (APTS).

In the APTS configuration, PTP is used as a backup timing source to a local time reference (e.g., primary reference time clock (PRTC) based on the global navigation satellite system (GNSS)) for durations up to 72 h. It is not intended to use PTP as the primary timing source.

Network requirements take into consideration the dynamic time error (dTE) generated by the network.

2) Partial timing support from the network (PTS).

In the PTS configuration, PTP is used as the primary source of time to the end application. In this mode, a local time reference (e.g., GNSS) is not available.

Network requirements take into consideration the combination of both the constant time error (cTE) and dTE components generated by the network.

A network that is based on the architecture defined in [ITU-T G.8265], and is designed to meet the network limits for frequency defined in [ITU-T G.8261.1], is not designed for the delivery of accurate time or phase, which requires much lower levels of packet delay variation (PDV) and asymmetry. The network limits specified in this document are for small, well-controlled networks (e.g., in-building or last-mile network segments), which can guarantee that the stringent PDV and asymmetry network limits are met. Further guidance can be found in Appendix II.

The necessary clock specifications are for further study.

The packet networks that are in the scope of this Recommendation are currently limited to the following types:

- Ethernet: [IEEE 802.3] and [IEEE 802.1Q]
- Multiprotocol label switching (MPLS): [IETF RFC 3031] and [ITU-T G.8110]
- Internet protocol (IP): [IETF RFC 791] and [IETF RFC 2460]

The use of other network types are for further study.

The physical layer that is relevant to this specification is the Ethernet media types as defined in [IEEE 802.3].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T G.810] Recommendation ITU-T G.810 (1996), *Definitions and terminology for synchronization networks*.
- [ITU-T G.8110] Recommendation ITU-T G.8110/Y.1370 (2005), *MPLS layer network architecture*.
- [ITU-T G.8260] Recommendation ITU-T G.8260 (2015), *Definitions and terminology for synchronization in packet networks*.
- [ITU-T G.8261.1] Recommendation ITU-T G.8261.1/Y.1361.1 (2012), *Packet delay variation network limits applicable to packet-based methods (Frequency synchronization)*.
- [ITU-T G.8265] Recommendation ITU-T G.8265/Y.1365 (2010), *Architecture and requirements for packet-based frequency delivery*.
- [ITU-T G.8271] Recommendation ITU-T G.8271/Y.1366 (2016), *Time and phase synchronization aspects of packet networks*.
- [ITU-T G.8271.1] Recommendation ITU-T G.8271.1/Y.1366.1 (2013), *Network limits for time synchronization in packet networks*.
- [ITU-T G.8272] Recommendation ITU-T G.8272/Y.1367 (2015), *Timing characteristics of primary reference time clocks*.
- [ITU-T G.8275] Recommendation ITU-T G.8275/Y.1369 (2017), *Architecture and requirements for packet-based time and phase distribution*.
- [ITU-T G.8275.1] Recommendation ITU-T G.8275.1/Y.1369.1 (2016), *Precision time protocol telecom profile for phase/time synchronization with full timing support from the network*
- [ITU-T G.8275.2] Recommendation ITU-T G.8275.2/Y.1369.2 (2016), *Precision time protocol telecom profile for time/phase synchronization with partial timing support from the network*.
- [IEEE 802.1Q] IEEE 802.1Q-2014, *IEEE Standard for local and metropolitan area networks – Bridges and bridged networks*.
- [IEEE 802.3] IEEE 802.3-2015, *IEEE Standard for Ethernet*.
- [IEEE 1588-2008] IEEE 1588-2008, *IEEE Standard for a precision clock synchronization protocol for networked measurement and control systems*.
- [IETF RFC 791] IETF RFC 791 (1981), *Internet protocol (IP)*.
- [IETF RFC 2460] IETF RFC 2460 (1998), *Internet Protocol, Version 6 (IPv6) – Specification*.

[IETF RFC 3031] IETF RFC 3031 (2001), *Multiprotocol label switching architecture*.

3 Definitions

The terms and definitions used in this Recommendation are contained in [ITU-T G.810] and [ITU-T G.8260]

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

APTS	Assisted Partial Timing Support
cTE	constant Time Error
dTE	dynamic Time Error
<u>FTS</u>	<u>Full Timing Support</u>
GNSS	Global Navigation Satellite System
IWF	Interworking Function
<u>IWF F-P</u>	<u>Interworking Function from FTS to PTS</u>
<u>IWF P-F</u>	<u>Interworking Function from PTS to FTS</u>
MPLS	Multiprotocol Label Switching
PDV	Packet Delay Variation
PRC	Primary Reference Clock
PRS	Primary Reference Source
PRTC	Primary Reference Time Clock
PTP	Precision Time Protocol
PTS	Partial Timing Support
T-BC	Telecom Boundary Clock
T-BC-P	Telecom Boundary Clock – Partial support
T-GM	Telecom Grandmaster
TLV	Type Length Variable
T-TSC	Telecom Time Slave Clock
T-TSC-A	Telecom Time Slave Clock – Assisted
T-TSC-P	Telecom Time Slave Clock – Partial support

5 Conventions

Within this Recommendation, the following conventions are used: the term PTP refers to the protocol defined in [IEEE 1588-2008].

The term telecom boundary clock – partial support (T-BC-P) is a device consisting of a boundary clock as defined in [IEEE 1588-2008], with only PTS at the protocol level from the network, and with additional performance characteristics for further study.

The term telecom time slave clock – assisted (T-TSC-A) (e.g., by GNSS) is a device consisting of a PTP slave only ordinary clock as defined in [IEEE 1588-2008], assisted by a local time reference clock device, and with additional performance characteristics for further study.

