International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.703

Amendment 1

(08/2013)

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

Digital terminal equipments – General

Physical/electrical characteristics of hierarchical digital interfaces

Amendment 1 – Specifications for the physical layer of the new ITU-T G.8271/Y.1366 time synchronization interfaces

Recommendation ITU-T G.703 (2001) – Amendment 1

International Telecommunication Union

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
General	**G.700–G.709**
Coding of voice and audio signals	G.710–G.729
Principal characteristics of primary multiplex equipment	G.730–G.739
Principal characteristics of second order multiplex equipment	G.740–G.749
Principal characteristics of higher order multiplex equipment	G.750–G.759
Principal characteristics of transcoder and digital multiplication equipment	G.760–G.769
Operations, administration and maintenance features of transmission equipment	G.770–G.779
Principal characteristics of multiplexing equipment for the synchronous digital hierarchy	G.780–G.789
Other terminal equipment	G.790–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
ACCESS NETWORKS	G.9000–G.9999

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

Recommendation ITU-T G.703

Physical/electrical characteristics of hierarchical digital interfaces

Amendment 1

Specifications for the physical layer of the new ITU-T G.8271/Y.1366 time synchronization interfaces

Summary

Amendment 1 to Recommendation ITU-T G.703 (2001) adds specifications for the physical layer of the new time synchronization interfaces defined in Recommendation ITU-T G.8271/Y.1366.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T G.703	1972-12-15	
2.0	ITU-T G.703	1976-10-08	
3.0	ITU-T G.703	1980-11-21	
4.0	ITU-T G.703	1984-10-19	
5.0	ITU-T G.703	1988-11-25	
6.0	ITU-T G.703	1991-04-05	XVIII
7.0	ITU-T G.703	1998-10-13	15
8.0	ITU-T G.703	2001-11-29	15
8.1	ITU-T G.703 (2001) Cor. 1	2008-03-29	15
8.2	ITU-T G.703 (2001) Amd. 1	2013-08-29	15

FOREWORD

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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.

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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/.

Recommendation ITU-T G.703

Physical/electrical characteristics of hierarchical digital interfaces

Amendment 1

Specifications for the physical layer of the new ITU-T G.8271/Y.1366 time synchronization interfaces

1) Introduction

This amendment adds specifications for the physical layer of the new time synchronization interfaces defined in ITU-T G.8271/Y.1366.

2) Additions

2.1) References

Add the following reference to clause 2:

[ITU-T G.8271] Recommendation ITU-T G.8271/Y.1366 (2012), *Time and phase synchronization aspects of packet networks*.

[ITU-T V.11] Recommendation ITU-T V.11 (1996), *Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s.*

[IEC 60603-7] IEC 60603-7 ed3.1 Consol. with am1 (2011-12), *Connectors for electronic equipment - Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*.

2.2) Abbreviations

Add the following abbreviations to clause 3:

GND Ground

GNSS Global Navigation Satellite System

1PPS One Pulse Per Second

2.3) New clause 17

Add the following new clause 17:

17 Time synchronization interfaces defined in ITU-T G.8271/Y.1366

17.1 ITU-T V.11-based time/phase distribution interface

The ITU-T V.11-based time/phase distribution interface provides an indication of the time of day and the one pulse per second (1PPS) signal as a phase indication. The expected physical connector is commonly referred to as the RJ-45 connector [IEC 60603-7].

The 1PPS time/phase interface uses a point-to-point ITU-T V.11 interface as specified in [ITU-T V.11] with an additional requirement on the rise and fall times of the 1PPS signal. This is needed to provide the accuracy required for the 1PPS signal.

This interface can be used for time synchronization distribution as well as for time measurement.

The interface is a balanced interface that can tolerate significant common mode noise.

The 1PPS interface consists of a balanced 100 ohm 1PPS differential signal that can be used to connect to another timing device or to measurement equipment.

The following mapping of signals is defined for use with the RJ-45 connector:

Two modes are supported:

1) Time input mode (the unit receives a time synchronization signal from an external time sync master).
2) Time output mode (the unit outputs a time synchronization signal towards an interface). The receiver of this time sync signal would be a unit operating in time input mode. This could be either test equipment or a time slave clock.

In the event that both time input and time output modes are required at the same time, two RJ-45 connectors are required.

Table 17-1 – RJ-45 connector operating in time input mode

PIN	Signal name	Signal definition
1	Reserved	For further study
2	Reserved	For further study
3	1PPS_IN–	Rx 1PPS negative voltage
4	GND	ITU-T V.11 signal ground
5	User defined	Note
6	1PPS_IN+	Rx 1PPS positive voltage
7	RX–	Rx TOD time message negative voltage
8	RX+	Rx TOD time message positive voltage
NOTE – One possible use of Pin 5 may be ground (GND). An alternative use for this pin could be considered when connected to GNSS receivers. This is out of the scope of this Recommendation. If the signal is not used, it is recommended to pull it down with a resistor of 10 kΩ.		

Table 17-2 – RJ-45 connector operating in time output mode

PIN	Signal name	Signal definition
1	Reserved	For further study
2	Reserved	For further study
3	1PPS_OUT–	Tx 1PPS negative voltage
4	GND	ITU-T V.11 signal ground
5	GND (Note)	ITU-T V.11 signal ground
6	1PPS_OUT+	Tx 1PPS positive voltage
7	TX–	Tx TOD time message negative voltage
8	TX+	Tx TOD time message positive voltage
NOTE – The time interface discussed in this Recommendation generally concerns transport equipment. For the time output mode interface of a GNSS receiver, similar considerations concerning Pin 5 to those made in the Note to Table 17-1 would be required.		

If only one mode is required, a single RJ-45 can be used and configured as time input or time output mode:

Table 17-3 – RJ-45 connector when only one mode is used

PIN	Signal name – Time input configuration	Signal name – Time output configuration	Signal definition
1	Reserved (Note 1)	Reserved	For further study
2	Reserved (Note 1)	Reserved	For further study
3	1PPS_IN–	1PPS_OUT–	Rx or Tx 1PPS negative voltage
4	GND	GND	ITU-T V.11 signal ground
5	User defined (Note 2)	GND	Note 2
6	1PPS_IN+	1PPS_OUT+	Rx or Tx 1PPS positive voltage
7	RX–	TX–	Rx or Tx TOD time message negative voltage
8	RX+	TX+	Rx or Tx TOD time message positive voltage
NOTE 1 – The use of Pin 1 and Pin 2 is not yet defined. They may be used for the measurement of 1PPS signal delay or may be used for configuring a GNSS receiver unit. Pin 1 and Pin 2 may be differential signals. NOTE 2 – One possible use of Pin 5 in the input configuration may be GND. Alternative usage could be considered when connected to GPS receivers. This is out of the scope of this Recommendation. If the signal is not used, it is recommended to pull it down with a resistor of 10 kΩ.			

17.1.1 1PPS rise and fall time specification

The maximum rise and fall times of the 1PPS_OUT signal pair at the output port are more stringent than those specified in clause 5.3 of [ITU-T V.11]. Values are for further study. The positive pulse width must be between 100 ns and 500 ms.

17.1.2 Signal timing

The time master must generate a positive pulse on the 1PPS signal such that the midpoint of the leading edge of the differential ITU-T V.11 signal at the edge of the chassis occurs at the change of the one-second time of the system.

The cable delays of the 1PPS signal must be controlled and compensated if needed in the receiving side so as to meet the requirements stated in Table 17-4. This may be done either manually by the network operator or automatically by the equipment.

Table 17-4 – Timing budget for time distribution of the 1PPS interface

Parameter	Tolerance	Reference point
1PPS signal generation accuracy of the timing master	±10 ns	
Cable delay compensation accuracy (Note 1)	±10 ns	From connector to connector with an ITU-T V.11 pulse
1PPS signal detection accuracy at the slave	Note 2	
NOTE 1 – The applicable cable length is for further study (values between 3 m and 1000 m have been proposed; contributions are invited). NOTE 2 – A range between 10 and 30 ns has been mentioned, and 30 ns are agreed as worst case. NOTE 3 – The specification of the rise and fall time is for further study.		

17.2 1PPS 50 Ω phase-synchronization measurement interface

The 1PPS interface consists of an unbalanced 50 ohm 1PPS signal that can be used to connect to measurement equipment.

NOTE – The unbalanced 50 ohm 1PPS measurement output may be used for phase distribution assuming that the distribution interface complies with the limits set in Table 17-4. If time distribution is required, an additional interface is required in order to transfer the corresponding time synchronization information. This additional interface is out of the scope of this Recommendation.

As an example, a 1PPS interface consisting of an unbalanced 50 ohm signal has been used as the distribution interface in some legacy equipment that only required phase/frequency synchronization.

17.2.1 Performance specification

This signal indicates the significant event occurring on the midpoint of the leading edge of the signal.

The system must generate a positive pulse on the 1PPS signal such that the midpoint of the leading edge of the signal at the edge of the chassis occurs at the one second roll-over of the system.

The pulse width must be between 100 ns and 500 ms.

The 10-90% rise times of the 1PPS pulse should be < 5 ns.

This interface is intended to be used with an impedance controlled 50 ohm cable with a maximum length of three metres to keep the influence of delay and rise time low.

Table 17-5 – Timing specification for the 1PPS measurement interface

Parameter	Tolerance	Comment
1PPS signal generation accuracy of the timing master	±5 ns	Measured at the 50% amplitude level
Maximum cable length	3 m	Due to delay and rise time performance

17.2.2 Voltage levels

Table 17-6 gives voltage levels for the interface for information.

Table 17-6 – Output voltage levels

Interface	VOH (max)	VOH (min)	VOL (max)	VOL (min)
1PPS (50 ohm single-ended)	5.5 V	1.2 V	0.3 V	–0.3 V
NOTE – Measured with a 50 ohm load to ground.				

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