International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.984.3

Amendment 3
(12/2006)

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

Digital sections and digital line system – Optical line systems for local and access networks

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Gigabit-capable Passive Optical Networks (G-PON): Transmission convergence layer specification

Amendment 3

ITU-T Recommendation G.984.3 (2004) – Amendment 3

International Telecommunication Union

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ITU-T Recommendation G.984.3

Gigabit-capable Passive Optical Networks (G-PON): Transmission convergence layer specification

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Summary

This amendment includes various clarifications and enhancements to [ITU-T G.984.3].

Source

Amendment 3 to ITU-T Recommendation G.984.3 (2004) was approved on 14 December 2006 by ITU-T Study Group 15 (2005-2008) under the ITU-T Recommendation A.8 procedure.

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.

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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 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/.

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1 Introduction

The G-PON TC layer specification, [ITU-T G.984.3], requires several small modifications to make certain points clearer, and to add some new functionality, including the carriage of SDH TUs over GEM. This amendment provides the language to implement these changes and additions.

2 Modifications to existing clauses of [ITU-T G.984.3]

2.1 Clause 9.2.3.1 Upstream_Overhead message

In the description of octet 10, append the text "Note 4".

Add the following note:

"NOTE 4 – Be mindful that the coding of the power level modes in the upstream overhead message, where 0 is highest and 2 is lowest, is opposite to that in the serial_number_ONU message."

2.2 Clause 9.2.3.8 Encrypted_VPI/Port-ID message

Add a note at the end of the table:

"NOTE – This message is not required to complete ranging, or to make any connection active. It can be issued at any time in the life of a connection. Changing the encryption mode of an active connection will likely cause temporary service interruption."

2.3 Clause 9.2.4.1 Serial_Number_ONU message

In the description of octet 12, append the text "Note 2".

Add the following note:

"NOTE 2 – Be mindful that the coding of the power level modes in the serial_number_ONU message, where 2 is highest and 0 is lowest, is opposite to that in the upstream_overhead message."

2.4 Clause 9.2.4.5

Modify the note at the end of the table to read as follows:

"NOTE – The first fragment of the key (bytes 0-7) will have Frag_Index = 0, the second (bytes 8-15) will have Frag_Index = 1, and so on, for as many fragments are required to carry the key. Currently, only two fragments are required for AES-128."

2.5 Clause 11.1.1 Items detected at OLT

In the SFi row, in the cancellation conditions column, replace "$< 10^{-y+1}$" with "$< 10^{-(y+1)}$".

In the SDi row, in the cancellation conditions column, replace "$< 10^{-x+1}$" with "$< 10^{-(x+1)}$".

Add the following two rows to the table:

TIWi	Timeslots Interference Warning	In any sequential N frames, an ONT transmission is received at any unexpected place	Generate Loss_of_phy_layer_I notification	In any sequential N frames, an ONT transmission is received at expected place	
TIA	Timeslots Interference Alarm	An ONT turns on its laser in any unassigned timeslots for it	Generate Loss_of_phy_layer_I notification	The faulty ONU is corrected or eliminated	

2.6 Appendix I Transport of user traffic over GEM channels

Change the introductory paragraph to this appendix so that it reads as follows:

"This appendix will contain informative material concerning the transport of common user protocols using the GEM channel in G-PON.

It should be noted that there are several implementation options for the carriage of TDM services over GEM. The raw TDM data can be sent over GEM directly (see I.2); or the TDM can be packaged into Ethernet, which is then sent over GEM (see I.3); or the TDM can be packaged into SDH tributary units, which is then sent over GEM (see I.4). The choice of option should be directed by the system architecture. For example, if the service stream is destined to be switched/routed across the wide area network, then Ethernet encapsulation is preferable. Alternatively, if the service stream will be terminated locally at the OLT equipment, then SDH encapsulation is preferable."

3 New clause I.4

Add the following new clause:

I.4 SDH over GEM

[ITU-T G.707/Y.1322] defines Tributary Unit (TU) structures. These structures contain user data as well as several mechanisms to preserve and recover data timing that is independent from the transport system timing. GEM can provide the same type of synchronous transport as SDH can, so it is possible to carry TU structures over GEM. This clause lays out the details of this method.

I.4.1 Review of SDH TU structures

In SDH transmission structures, a TU includes a low level VC and a TU PTR. There are 4 types of TUs: TU-11, TU-12, TU-2, and TU-3. A TU-11 is used to carry DS1 service. A TU-12 is used to carry E1 service. A TU-2 is used to carry a DS2 service, and a TU-3 is used to carry a DS3 or E3 service.

The TU-x structures are illustrated in Figures I.4 to I.6. Note that the bytes shown in the diagram are ordered starting at the upper left, going left to right, then on to the next line, and so forth.

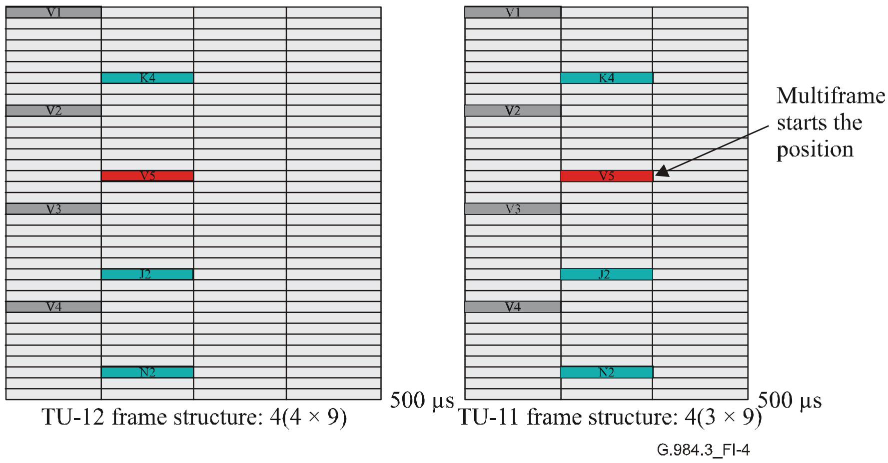

Figure I.4 – The TU-12 and TU-11 frame structures

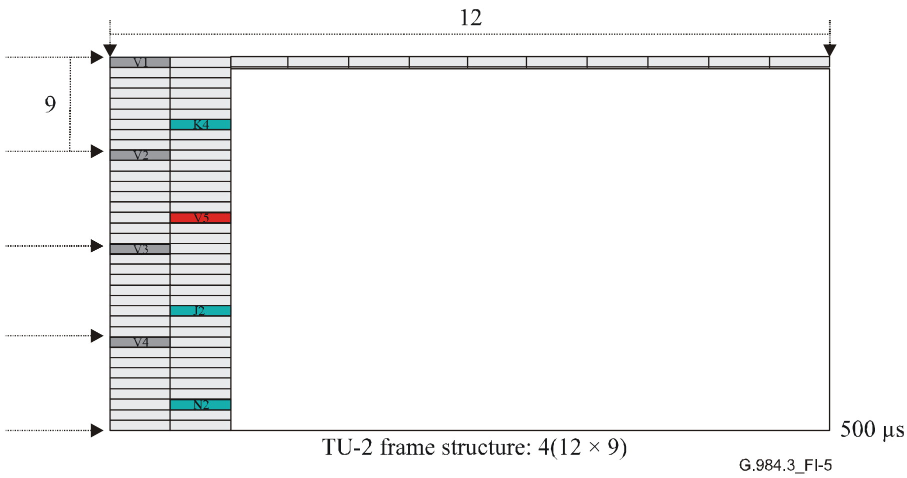

Figure I.5 – The TU-2 frame structure

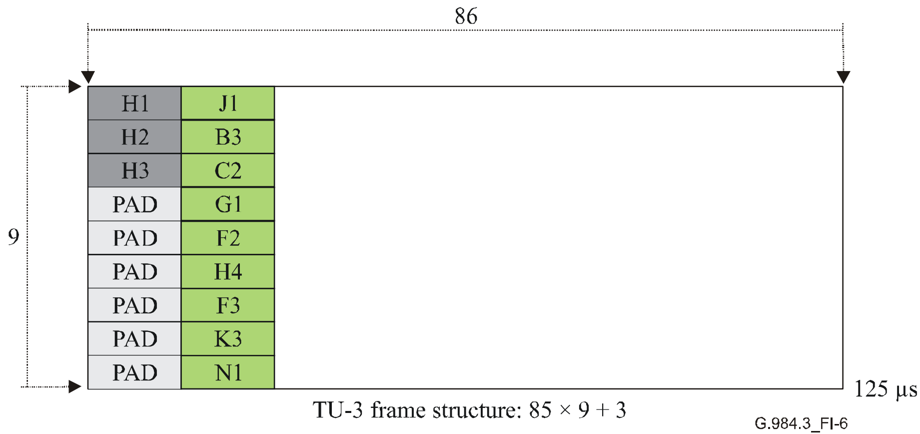

Figure I.6 – The TU-3 frame structure

The structure and function of the pointers in the V1, V2, and V3 bytes in the TU-11, TU-12, and TU-2; and in the H1, H2 and H3 bytes in a TU-3 frame, continue to operate exactly as described in [ITU-T G.707/Y.1322].

I.4.2 Transport of TU structures over GEM

The structure about a TU frame mapped into a GEM frame is shown below:

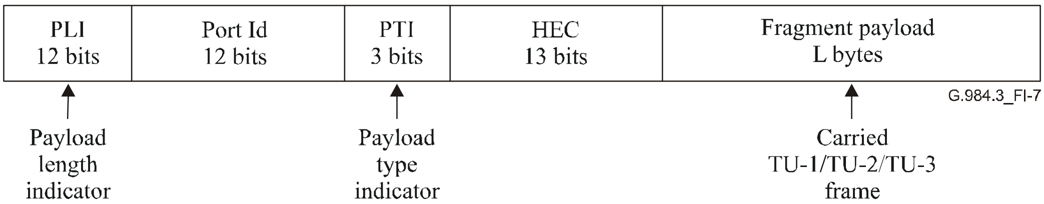

Figure I.7 – GEM frame structure with TU frame data payload

Each TU connection is assigned its own GEM Port-ID. Each TU frame always has a fixed size. This size depends on the type of TU being carried. In addition, the GEM process receives a TU frame exactly once every transmission cycle. This cycle period is measured in the time-base of the G-PON system, which is a synchronous transport system with traceable timing. Hence, clock integrity can be maintained. It should be noted that GEM fragmentation is permitted; however, some implementations may attempt to coordinate the G-PON framing and SDH framing processes such that fragmentation is avoided.

The length and transmission period of TU-1/TU-2/TU-3 encapsulated in a GEM frame are shown below:

TU type	**Payload length in GEM (bytes)**	**Transmission cycle**
TU-11	$4(3 \times 9) = 108$	500 µs
TU-12	$4(4 \times 9) = 144$	
TU-2	$4(12 \times 9) = 432$	
TU-3	$85 \times 9 + 3 = 768$	125 µs

The payloads are assembled using the structures as shown in Figures I.4 to I.6. Note that in the case of the TU-3, the 6 fixed stuff bytes (marked 'pad' in Figure I.6) are not transported, because they carry no useful information.

The receiver side can identify the type of the carried TUs in two ways. Primarily, the Port-ID used would have a provisioned association with the TU that it is carrying. Secondarily, the length of the payload would give an additional check on the TU type, since the payload lengths are fixed for each TU type.

Note that while the GEM frame generation process is locked to the G-PON frame timing, there can still be delays in the frame transmission caused by low-level PON processes (e.g., ranging). For typical ranging procedures, two frames at a time are used for ranging. Therefore, the receiving process at the OLT must queue up sufficient TU data so that the client SDH processor can be served with its TU payloads synchronously.

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