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ITU-T

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G.984.3

Amendment 1

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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 1 – Specification of the ONU registration method and various clarifications

Recommendation ITU-T G.984.3 (2008) – Amendment 1

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Recommendation ITU-T G.984.3

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

Amendment 1

Specification of the ONU registration method and various clarifications

Summary

Amendment 1 to Recommendation ITU-T G.984.3:

– specifies the ONU registration method;

– clarifies the definitions of Dying_Gasp and Deactivate_ONU-ID PLOAM messages;

– reconciles the description of PON alarms;

– adds a new appendix clause addressing transmission of MPLS datagrams using the G-PON encapsulation method;

– provides necessary clarifications to several standard items, including the use of the DBA reference model, the required number of supported reassembly buffers, and details of the key exchange.

Source

Amendment 1 to Recommendation ITU-T G.984.3 (2008) was approved on 13 February 2009 by ITU-T Study Group 15 (2009-2012) under Recommendation ITU-T A.8 procedures.

FOREWORD

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Amendment 1

Specification of the ONU registration method and various clarifications

1 Introduction

This amendment contains several improvements and editorial corrections aimed at enhancing the readability and utility of the Recommendation. This amendment:

– specifies the ONU registration method;

– clarifies the definitions of Dying_Gasp and Deactivate_ONU-ID PLOAM messages;

– reconciles the description of PON alarms;

– adds a new appendix clause addressing transmission of MPLS datagram using the G-PON encapsulation method;

– provides necessary clarifications to several standard items, including the use of the DBA reference model, the required number of supported reassembly buffers, and details of the key exchange.

2 ONU registration method

2.1 Clause 7.2.2

Replace the text of clause 7.2.2 with the following text:

When an ONU is activated on the PON, it first cooperates with the OLT to attain synchronization, establish the physical layer OAM channel and achieve ranging. Because the PON is a point-to-multipoint system, it is then necessary to register the ONU to a particular subscriber. In most current business models, billing and privacy concerns imply that only after the ONU is properly registered can it be provisioned with a valid set of services.

Appendix VI describes the ways in which an ONU may be registered to a subscriber.

2.2 Appendix IV

Replace the first two paragraphs of clause IV.3 with the following text:

The activation procedure described above is applicable for several types of ONU activation methods.

In one activation method, the G-PON protocol relies on the unique serial number of the ONU for identification and provisioning purposes. Some operators will use an operations system that pre-provisions ONUs based on serial number, the configured-SN activation method. In other situations, the serial numbers of the ONUs are unknown initially and therefore must be discovered. G-PON allows for an automatic discovery method to accommodate this situation.

An automatically discovered ONU may be associated with a subscriber through its PLOAM password, as described in clause VI.2. If the OLT supports registration ID activation, it can bring a discovered ONU into service based on its registration ID, and learn the ONU's serial number for future use. Once the ONU is in service, the operations system can change the OLT mode to recognize the ONU by its serial number instead of, or in addition to, its PLOAM password during future ranging operations. The operations system may subsequently invoke the registration ID mode again for ONU repair or replacement.

2.3 New Appendix VI

Add a new appendix as follows:

Appendix VI

ONU registration methods

(This appendix does not form an integral part of this Recommendation)

When an ONU is activated on the PON, it first cooperates with the OLT to attain synchronization, establish the physical layer OAM channel and achieve ranging. Because the PON is a point-to-multipoint system, it is then necessary to register the ONU to a particular subscriber. In most current business models, billing and privacy concerns imply that only after the ONU is properly registered can it be provisioned with a valid set of services.

There are several methods to register an ONU. An operator may wish to use one method for initial installation or replacement of an ONU, and a different method to recognize an existing ONU during subsequent activations. For example, authenticating a newly activated ONU by serial number allows for increased security during normal operation, whereas authenticating an ONU by PLOAM password allows for flexibility during installation and repair. In the latter case, the ONU being installed does not have to be specified in advance but can be selected by the technician from a pool of ONUs with suitable characteristics, thus simplifying the logistics of installation and repair.

To support these registration methods, the OLT would have several modes, which may be governed by management action or by timed transitions. The details of OLT mode control are beyond the scope of this Recommendation.

VI.1 Authentication by serial number

This method assumes that the association between the serial number (and, optionally, the PLOAM password) of the ONU and the specific subscriber is already established at the OLT either through pre-provisioning or in the course of previous activations. Because this method is the most straightforward in terms of PLOAM overhead, it is recommended for ONUs once their initial registration on the PON has been completed.

In addition to the serial number, the PLOAM password, which is pre-provisioned (if fixed and known *a priori*) or learned at the previous activations (for example, if randomly generated), can be used for verification purposes.

VI.2 Authentication by PLOAM password

This method assumes that a registration ID is assigned to a subscriber at the management level, and provisioned both into the OLT and communicated to installation or repair personnel or even to the subscriber directly. There is a method for entering the registration ID into the ONU in the field. Specification of such a method is beyond the scope of this Recommendation.

The registration ID populates the ONU's PLOAM password, which is used by the OLT to recognize the ONU. The OLT may learn the value of the ONU's serial number for possible subsequent use in serial number based authentication.

VI.3 Other forms of authentication

Additional ways to associate an ONU with a given subscriber, for example, the registration of the ONU's MAC address in a database, are not precluded. However, such possibilities are beyond the scope of this Recommendation.

3 PLOAM Messages

3.1 Definition of the Dying_Gasp

1) *Amend the Dying_Gasp message definition in clause 9.2.2 as follows:*

3	Dying_Gasp	To inform the OLT that the ONU is powering off, is transitioning into a low power or battery conservation mode, or otherwise experiences or desires to effectuate a change in the powering conditions that may impact the ONU's ability to respond to the upstream bandwidth allocations. This is to prevent the OLT from issuing unnecessary alarm reports and to prompt extra diagnostic actions as deemed necessary. An ONU issuing a Dying_Gasp is not required to actually power off, and the OLT should not take the Dying_Gasp by itself as the grounds to stop bandwidth allocations to the given ONU.	The ONU generates this message when it experiences or desires to effectuate a change in the powering conditions	At least 3 times.	The OLT informs the operation support system, optionally performing extra diagnostics via the OMCC. The OLT should continue to provide bandwidth allocations to the ONU, but suppress and not report to the OSS the LOSi alarms that are raised, should the ONU fail to respond to these allocations. The bandwidth allocation patterns and the conditions to end the LOSi suppression depend on the reason triggering the Dying_Gasp transmission, as determined by the OLT. See Note below for an example of such DG trigger-specific behaviour.

2) *Insert the following explanatory note after the table in clause 9.2.2:*

NOTE – Consider as an example the OLT behaviour upon receipt of a Dying_Gasp, it concludes that the ONU is about to lose power without battery backup. If this is the case, the OLT initiates an implementation-specific timer defining the temporal scope of the Dying_Gasp, and continues to provide the regular pattern of bandwidth allocations to the affected ONU. The temporal scope of the Dying_Gasp can be expected to be much longer than the timer TO2.

If a persistent LOSi condition (i.e., an LOSi that is not cleared by the directed POPUP process; see clause 11.1.1 for the definition of items detected at the OLT) occurs within the temporal scope of the Dying_Gasp, the OLT should assume that the power has been lost indeed. Consequently, it may stop regular bandwidth allocations to the ONU and increase the frequency of the broadcast SN requests. However, it does not issue a notification to the OSS and does not attempt to forcibly deactivate the ONU. If the OLT chooses to continue to provide allocations to the ONU (for example, providing targeted ranging allocations in support

of a power saving behaviour), it should ignore any LOSi conditions up to the moment the ONU responds to such targeted allocation with a valid PLOAM message or announces itself with a contention-oriented Serial_Number_ONU PLOAM.

Further, consider a situation in which the ONU that has submitted a Dying_Gasp does not lose power. If within the temporal scope of the Dying_Gasp it experiences an intermittent LOS condition, it enters the POPUP state (O6) in a usual way and can return to Operation state (O5) upon receipt of a directed POPUP message. If the LOS condition experienced by the ONU is persistent (i.e., the TO2 timer is let to expire), the ONU falls back to the Initial state (O1) and waits for clearing the LOS condition to repeat the activation routine. As a result of the LOS occurring within the temporal scope of the Dying_Gasp, the OSS is not notified by the OLT of the LOSi condition associated with the given ONU.

3) *Remove the note at the end of Dying_Gasp format definition in clause 9.2.4.3:*

NOTE – The [ITU-T G.983.1] name of this message is R-INH.

3.2 Deactivate_ONU-ID message trigger

In the table of clause 9.2.1, downstream message definition, in line 4, specify the trigger for the Deactivate_ONU-ID message as follows:

When any of the following alarm conditions are raised at the OLT: LOSi (unless cleared by A POPUP message or suppressed by prior receipt of a Dying_Gasp), LOFi, LOKi, LOAi, LOAMi, SFi, SUFi.

3.3 POPUP message function

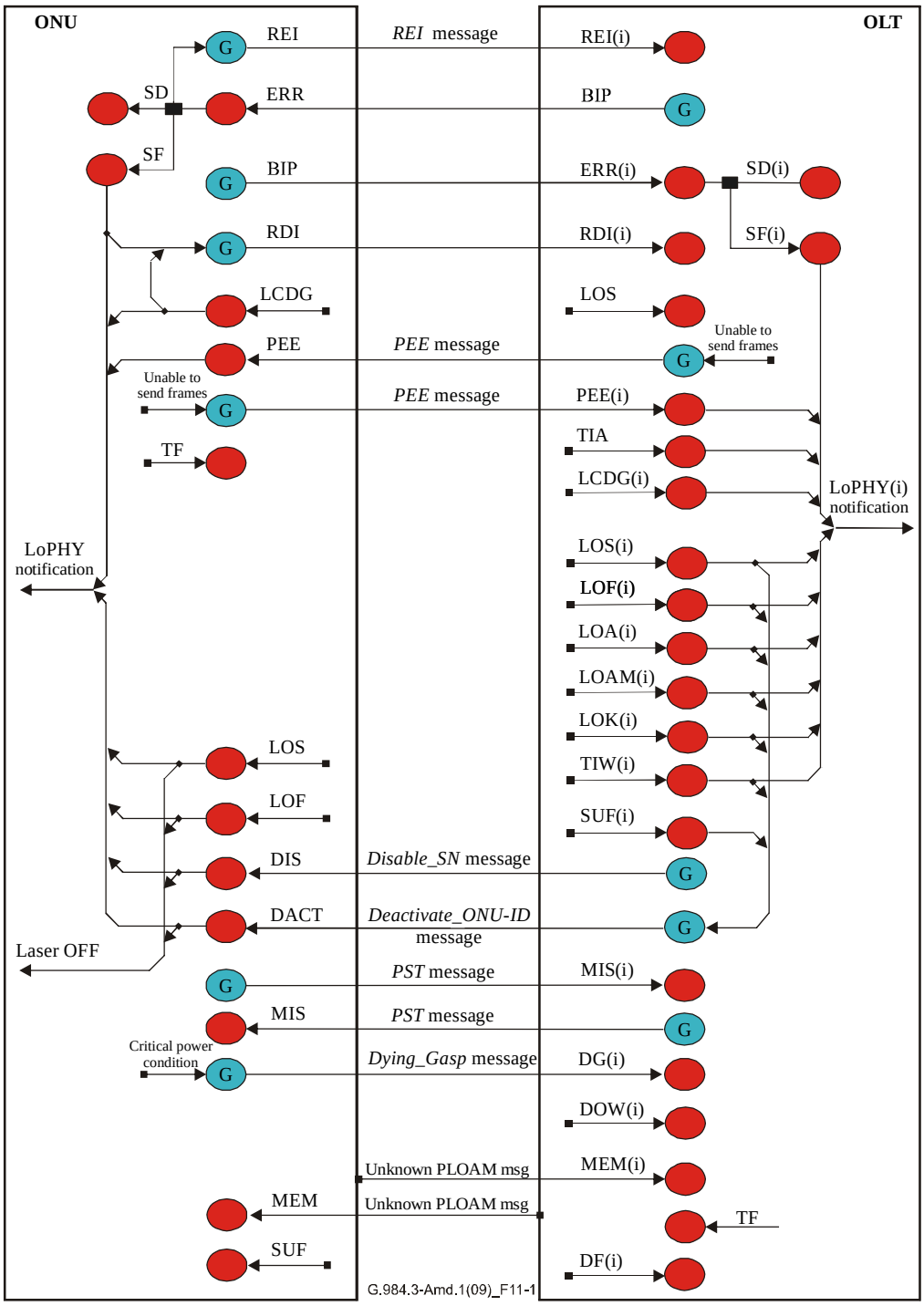
In the table of clause 9.2.1, downstream message definition, in line 10, rephrase the function column entry as follows:

The OLT forces all the ONUs which are in POPUP state (O6) and have the LOS/LOF condition cleared to go from POPUP state (O6) to Ranging state (O4) or commanding a specific ONU to go directly to Operation state (O5).

4 G-PON Alarms

4.1 Figure 11-1 Alarms

Add TIW(i), TIA, LOK(i); remove LCDA, LCDA(i), add index to RDI(i), REI(i).



4.2 Table in clause 11.1.1, items detected at OLT

1) *In the LOSi row, modify the description in the actions column as follows:*

If the OLT supports POPUP, it generates three POPUP messages.

If the LOSi alarming is not suppressed due to the prior Dying_Gasp message and either the OLT does not support POPUP or the LOSi condition is not cleared after the three POPUP messages, generate Loss_of_PHY_Layer_i notification and send three Deactivate_ONU-ID messages to the ONUi.

2) *In the DOWi row, rephrase the text in the detection conditions column to read as follows:*

In ***N*** sequential bursts from the given ONU, the transmission drift exceeds the lower of two specified drift thresholds. This condition indicates that while the transmission phase has shifted, it remains correctable via EqD update.

3) *In the TIWi row, change the description in the detection conditions column to:*

In ***N*** sequential bursts from the given ONU, the transmission drift exceeds the upper of two specified drift thresholds. This condition indicates that either the drift is occurring critically fast, or the attempt to correct the transmission phase through the EqD update has failed.

4) *In the TIWi row, add the following sentence to the actions column (appears in the description, clause 10.3.5):*

Send Deactivate_ONU-ID message 3 times.

5) *In the DGi row, rephrase the contents of the actions column to read as follows:*

Notify the OSS of the Dying_Gasp received. Optionally, perform extra diagnostics via the OMCC. While continuing to provide bandwidth allocations to the ONU, suppress and not report to the OSS the LOSi alarms that are raised, should the ONU fail to respond to these allocations.

6) *In the DGi row, rephrase the contents of the cancellation conditions column to read as follows:*

Depends on the DG trigger as determined by the OLT. For example, cancel DGi upon expiration of the DG temporal scope timer, if no LOSi occurs, or upon receipt of a valid PLOAM, if LOSi does occur.

7) *In the LOAMi row, modify the description in the detection conditions column as follows (failure to send a standalone PLOAM qualifies for LOSi; also see MEMi):*

When, in response to three consecutive PLOAM allocations, the ONU transmits the PLOAM field that has incorrect CRC or does not parse into a valid PLOAM message.

8) *Rephrase the contents of the actions column in the rows LOFi, SFi, LOAi, LOAMi, LOKi as follows:*

Generate Loss_of_PHY_Layer_i notification and send three Deactivate_ONU-ID messages to the ONUi.

4.3 Table in clause 11.1.2, ONU alarms

1) *Add Loss_of_PHY_Layer indication to the SF row.*

SF	Signal failed	When the downstream BER becomes ≥ 10^{-y}, this state is entered. Y is configurable in the range of 5 to 8.	Generate Loss_of_PHY_Layer notification.	Set inactive when the downstream BER is < $10^{-(y+1)}$.	–

2) *Add a note after the table.*

Note that, strictly speaking, switching off the ONU's laser is a result of the ONU activation state transition caused by the alarm, rather than by the alarm itself.

5 MPLS over GEM

Add a new clause I.6.

I.6 MPLS over GEM

Multi-protocol label switching packets are carried directly in the GEM frame payload. Each MPLS packet shall be mapped to a single GEM frame (as shown in Figure I.8) or multiple GEM frames, in which case the fragmentation rules of clause 8.3.3 apply.

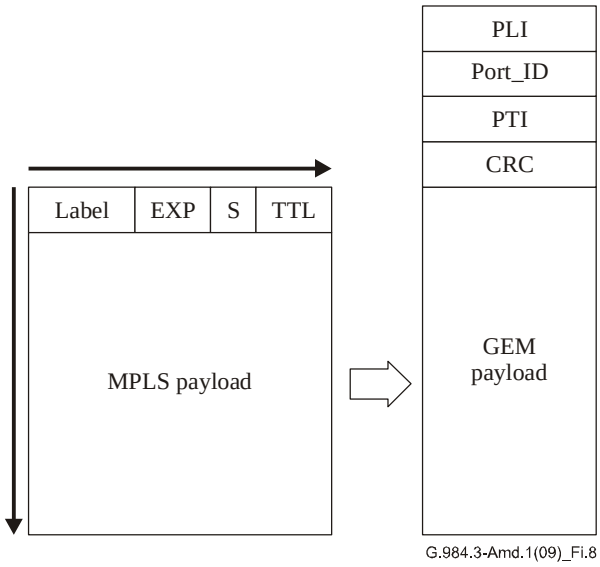


Figure I.8 – Frame structure for MPLS mapping into the GEM frame

6 Maintenance items

6.1 DBA reference model clarification

1) *Add the word "reference" to the first sentence of clause 7.4.4.8:*

"The reference bandwidth assignment model described herein ..."

2) *Add the following note at the end of clause 7.4.4.8:*

NOTE – An implementation may perform the non-assured bandwidth assignment in an iterative procedure. Ideally, the number of the iterative steps may approach the number of the eligible (χ_{AB} = NA) Alloc-IDs. However, running such a procedure to exhaustion is neither practical nor advisable. While stopping the iterations earlier leads to some fraction of the non-assured surplus bandwidth being distributed according to the best-effort criteria, an implementation should use clause 7.4.7 as the guideline to any approximation decision.

6.2 Number of reassembly buffers

Rewrite the last paragraph of clause 8.3.3, "User frame fragmentation" as follows:

Each ONU is required to have at least two GEM re-assembly buffers to support the usage of time-urgent fragmentation. The OLT should not interleave more than two user data frames to any single ONU. The OLT is required to have at least two GEM re-assembly buffers per Alloc-ID for the same purpose. The ONU should not interleave more than two user data frames for any Alloc-ID in the upstream direction.

6.3 Key exchange clarification

In clause 12.3, key exchange and switch-over, add the following paragraph before the paragraph "At the beginning of the chosen frame":

If after the ONU has acknowledged a Key_Switching_Time message but before the key switch is executed, the ONU receives a new Request_Key message, it generates a new key, overwriting the value previously stored in the shadow_key_register, and discards the previously chosen superframe number associated with the overwritten key. A new superframe number should be communicated to the ONU by a subsequent Key_Switching_Time message.

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