

International Telecommunication Union

**ITU-T**

TELECOMMUNICATION  
STANDARDIZATION SECTOR  
OF ITU

**G.993.2**  
**Amendment 3**  
(04/2013)

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

Digital sections and digital line system – Access networks

---

Very high speed digital subscriber line  
transceivers 2 (VDSL2)

**Amendment 3**

Recommendation ITU-T G.993.2 (2011) –  
Amendment 3



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
General	G.900–G.909
Parameters for optical fibre cable systems	G.910–G.919
Digital sections at hierarchical bit rates based on a bit rate of 2048 kbit/s	G.920–G.929
Digital line transmission systems on cable at non-hierarchical bit rates	G.930–G.939
Digital line systems provided by FDM transmission bearers	G.940–G.949
Digital line systems	G.950–G.959
Digital section and digital transmission systems for customer access to ISDN	G.960–G.969
Optical fibre submarine cable systems	G.970–G.979
Optical line systems for local and access networks	G.980–G.989
<b>Access networks</b>	<b>G.990–G.999</b>
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.993.2

### Very high speed digital subscriber line transceivers 2 (VDSL2)

#### Amendment 3

#### Summary

Amendment 3 to Recommendation ITU-T G.993.2 (2011) covers the following functionalities:

1. Data gathering function (new functionality).
2. Align with ITU-T G.997.1 VECTORMODE\_ENABLE (new functionality).
3. Loop diagnostic mode procedures in Annex Y (new functionality).

#### History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T G.993.2	2006-02-17	15
1.1	ITU-T G.993.2 (2006) Cor. 1	2006-12-14	15
1.2	ITU-T G.993.2 (2006) Amd. 1	2007-04-06	15
1.3	ITU-T G.993.2 (2006) Amd. 1 Cor. 1	2007-07-29	15
1.4	ITU-T G.993.2 (2006) Cor. 2	2007-07-29	15
1.5	ITU-T G.993.2 (2006) Amd. 2	2008-02-06	15
1.6	ITU-T G.993.2 (2006) Amd. 3	2008-08-22	15
1.7	ITU-T G.993.2 (2006) Amd. 4	2009-01-13	15
1.8	ITU-T G.993.2 (2006) Cor. 3	2009-06-29	15
1.9	ITU-T G.993.2 (2006) Amd. 5	2010-04-22	15
1.10	ITU-T G.993.2 (2006) Amd. 6	2010-11-29	15
1.11	ITU-T G.993.2 (2006) Cor. 4	2011-04-13	15
1.12	ITU-T G.993.2 (2006) Amd. 7	2011-06-22	15
2.0	ITU-T G.993.2	2011-12-16	15
2.1	ITU-T G.993.2 (2011) Amd. 1	2012-04-06	15
2.2	ITU-T G.993.2 (2011) Cor. 1	2012-06-13	15
2.3	ITU-T G.993.2 (2011) Amd. 2	2012-12-07	15
2.4	ITU-T G.993.2 (2011) Amd. 3	2013-04-22	15

## 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 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 2013

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

## Recommendation ITU-T G.993.2

### Very high speed digital subscriber line transceivers 2 (VDSL2)

#### Amendment 3

#### 1) References

##### 1.1) New References

Add the following references to clause 2:

[ITU-T G.993.5] Recommendation ITU-T G.993.5 (2010), *Self-FEXT cancellation (vectoring) for use with VDSL2 transceivers*.

[ITU-T G.998.4] Recommendation ITU-T G.998.4 (2000), *Improved impulse noise protection for DSL transceivers*.

##### 1.2) Updated reference

Update reference ITU-T G.997.1 in clause 2, as shown:

[ITU-T G.997.1] Recommendation ITU-T G.997.1 (2012~~06~~), *Physical layer management for digital subscriber line-(DSL) transceivers*.

#### 2) Data gathering functionality at the VTU-O and VTU-R

##### 2.1) Clause 11.5

Add new clause 11.5 as follows:

##### 11.5 Data gathering function

The data gathering function stores records in a buffer, with each record entered in the buffer upon occurrence of a particular event type. These records may be used for diagnosing troubles and analysing functions. Different event types are defined; these are relevant to the operation of the line and are useful for determining what is functioning properly or what is not. Each event is recorded with a timestamp, the ID of the event type, and additional event data as defined for each event type.

The VTU-O may optionally support the data gathering function. If supported, then the data gathering function shall comply with this clause, as applicable to the VTU-O.

The VTU-R may optionally support the data gathering function. If supported, then the data gathering function shall comply with this clause, as applicable to the VTU-R.

The data gathering function uses both the ITU-T G.993.2 transceiver functionality and the ITU-T G.997.1 functionality. Support of some ITU-T G.997.1 functionality is required to implement this clause. The data gathering function shall include a buffer of *logging\_depth* records. Each record shall include the following three fields: Event Timestamp, Event Type and Event Data.

For each event type, a logging depth is defined as the minimum number of records of the event type that shall be kept in the buffer when deleting entries of this event type in case of buffer full condition. Per event type, the logging depth shall be configurable as a parameter derived from the configuration parameter *logging\_depth\_event\_percentage<sub>i</sub>* as follows:

$$logging\_depth\_event\_i = \lfloor (logging\_depth\_event\_percentage\_i / 100\%) \times logging\_depth \rfloor$$

The sum over all event types of the configured *logging\_depth\_event\_percentage<sub>i</sub>* shall not exceed 100%, i.e.,

$$\sum_i \text{logging\_depth\_event\_percentage}_i \leq 100 \%$$

NOTE – If the sum of *logging\_depth\_event<sub>i</sub>* is smaller than *logging\_depth*, then the remaining part of the buffer is used as a pool that can be used for any event type, within the buffer management rules defined in clause 11.5.2.

The control parameter, *logging\_depth\_event<sub>i</sub>*, is the minimum logging depth for event type *i* in number of 6-byte records, i.e., *logging\_depth\_event<sub>i</sub>* is the minimum number of records of event type *i* that shall be kept in the event buffer of the VTU. This is logically the same as having a separate buffer for each event type, with each of these buffers able to store at least *logging\_depth\_event<sub>i</sub>* records.

The maximum depth of the entire event buffer is reported by the VTU as *logging\_depth*.

The parameter *logging\_depth* is defined separately for the VTU-R and the VTU-O respectively as *logging\_depth\_R* and *logging\_depth\_O*. The reporting parameter *logging\_depth\_R* is the maximum depth of the buffer stored at the VTU-R and is reported in the CO-MIB as LOGGING\_DEPTH\_R (see clause 7.5.3.2 of [ITU-T G.997.1]). The reporting parameter *logging\_depth\_O* is the maximum depth of the buffer stored at the VTU-O and is reported in the CO-MIB as LOGGING\_DEPTH\_O (see clause 7.5.3.1 of [ITU-T G.997.1]).

The control parameter *logging\_depth\_event\_percentage<sub>i</sub>* is defined separately for the VTU-R and the VTU-O respectively as *logging\_depth\_event\_percentage\_R<sub>i</sub>* and *logging\_depth\_event\_percentage\_O<sub>i</sub>*. The control parameter *logging\_depth\_event\_percentage\_R<sub>i</sub>* shall have a value equal to the CO-MIB configuration parameter LOGGING\_DEPTH\_EVENT\_PERCENTAGE\_R<sub>i</sub> (see clause 7.3.6.2 of [ITU-T G.997.1]). The control parameter *logging\_depth\_event\_percentage\_O<sub>i</sub>* shall have a value equal to the CO-MIB configuration parameter LOGGING\_DEPTH\_EVENT\_PERCENTAGE\_O<sub>i</sub> (see clause 7.3.6.1 of [ITU-T G.997.1]).

At the VTU-O and VTU-R, the record length shall be fixed at 6 bytes (consisting of 4 bytes for the timestamp, 1 byte for the Event Type, and 1 byte for the Event Data).

At the VTU-O, the timestamps as presented at the Q-interface (towards the MIB) shall be the number of seconds since Jan 1, 1900 as defined in IETF RFC 1305 (NTP) coded in a 32-bit format. At the VTU-R, the timestamp as presented towards the U-interface (on the DSL) shall be the number of seconds since the last power cycle (mains power turned off/on) of the VTU-R, coded in a 32-bit format (with accuracy of time clock within ±50 ppm). The VTU-R timestamp shall be recorded in the CO-MIB in the same format as it presented toward the U-interface.

A single record of each event type shall be stored once each second, unless no event of this type occurred during that second. In case an event (with a particular event ID, as per Table 11-43) occurred multiple times during a one-second period, a single event shall be recorded with the timestamp for that one second period, and within this record the number of occurrences of the event may be reflected as a part of the Event Data.

The following subclauses identify which event types shall be supported by the VTU-O and/or VTU-R. The reporting of all supported event types is mandatory, i.e., there are no event types that are optionally supported.

Clause 11.2 defines the buffer management rules.

Clause 11.2.3.16 defines the mechanism for the VTU-O to retrieve over the eoc channel the data gathered in the VTU-R buffer.

The logging depth that is applied for reporting the VTU-R buffer over the eoc channel is *logging\_depth\_reporting*.

The VTU-O shall set *act\_logging\_depth\_reporting\_R* in the eoc configuration command message. The *act\_logging\_depth\_reporting\_R* shall be the minimum of:

- the *logging\_depth\_R* (indicated by the VTU-R in the eoc configuration response message);
- the maximum depth of the buffer at the VTU-O that stores the records originated at the VTU-R as reported over the eoc channel;
- the CO-MIB configuration parameter `LOGGING_DEPTH_REPORTING_R` (see clause 7.3.6.4 of [ITU-T G.997.1]).

When sending a first configuration command, the VTU-O is not aware of the *logging\_depth\_R*. If the configuration command message indicates an *act\_logging\_depth\_reporting\_R* that is higher than *logging\_depth\_R*, then the VTU-R shall send a NACK response, and the VTU-O shall send a new configuration command to satisfy the above three conditions.

The control parameter *act\_logging\_depth\_reporting\_R* is reported in the CO-MIB as `ACT_LOGGING_DEPTH_REPORTING_R` (see clause 7.5.3.4 of [ITU-T G.997.1]).

The VTU-O shall set *act\_logging\_depth\_reporting\_O*. The *act\_logging\_depth\_reporting\_O* shall be the minimum of:

- the *logging\_depth\_O*;
- the CO-MIB configuration parameter `LOGGING_DEPTH_REPORTING_O` (see clause 7.3.6.3 of [ITU-T G.997.1]).

The control parameter *act\_logging\_depth\_reporting\_O* is reported in the CO-MIB as `ACT_LOGGING_DEPTH_REPORTING_O` (see clause 7.5.3.3 of [ITU-T G.997.1]).

If *act\_logging\_depth\_reporting\_R* is strictly less than *logging\_depth\_R*, then the VTU-R may store more than *act\_logging\_depth\_reporting\_R* records. In this case however, the VTU-R shall virtually reduce the number of stored records to no more than *act\_logging\_depth\_reporting\_R* records by applying the buffer management rules of clause 11.5.2 before reporting records over the eoc channel. For the data gathering functionality defined in this Recommendation, the term "VTU-R buffer" shall refer to the storage of up to *act\_logging\_depth\_reporting\_R* records.

Upon a power cycle, the VTU-R:

- shall reset the entire buffer by setting all records to be dummy records, where a dummy record is defined as a record which has all fields set to the value 0, and,
- shall set *Nack* = 0, and,
- shall start data gathering with a reset of the timestamp to value 0, *act\_logging\_depth\_reporting\_R* = *logging\_depth\_R* and *logging\_depth\_percentage\_R<sub>i</sub>* = 0 for all event types (i.e., the VTU-R buffer operates as a pure FIFO until the *logging\_depth\_reporting* and *logging\_depth\_event\_percentage\_R<sub>i</sub>* are configured).

A VTU-R supporting the data gathering functionality shall support the "previous-loss-of-power" (PLPR) flag.

The records originated at the VTU-R (and reported to the VTU-O over the eoc channel) are contained in the CO-MIB parameter `EVENT_TRACE_BUFFER_R` (see clause 7.5.3.6 of [ITU-T G.997.1]). The maximum number of records contained in this CO-MIB parameter is `ACT_LOGGING_DEPTH_REPORTING_R` (see clause 7.5.3.4 of [ITU-T G.997.1]). In the case that the number of records contained in this CO-MIB parameter is less than `ACT_LOGGING_DEPTH_REPORTING_R`, the remainder of the `EVENT_TRACE_BUFFER_R` shall be set to all dummy records.

The records originated at the VTU-O are contained in the CO-MIB parameter EVENT\_TRACE\_BUFFER\_O (see clause 7.5.3.5 of [ITU-T G.997.1]). The maximum number of records contained in this CO-MIB parameter is ACT\_LOGGING\_DEPTH\_REPORTING\_O (see clause 7.5.3.3 of [ITU-T G.997.1]). In the case that the number of records contained in this CO-MIB parameter is less than ACT\_LOGGING\_DEPTH\_REPORTING\_O, the remainder of the EVENT\_TRACE\_BUFFER\_O shall be set to all dummy records.

### 11.5.1 Event types and event data

Table 11-43 lists the event types defined for the data gathering function, and the identifier that shall be used in the record to identify the event type. Table 11-43 also indicates whether the event type shall be supported by the VTU-O and/or VTU-R (M indicates "mandatory support" and O indicates "optional support").

**Table 11-43 – List of Event types**

Event type	ID	VTU-O	VTU-R	Definition
Dummy	00 <sub>16</sub>	M	M	See clause 11.5
End of Showtime	01 <sub>16</sub>	M	M	See clause 11.5.1.1
Previous End Of Showtime	02 <sub>16</sub>	M	M	See clause 11.5.1.2
Failed Init	03 <sub>16</sub>	M	M	See clause 11.5.1.3
Successful Init	04 <sub>16</sub>	M	M	See clause 11.5.1.4
Downstream Init Net Data Rate	05 <sub>16</sub>	M	M	See clause 11.5.1.5
Upstream Init Net Data Rate	06 <sub>16</sub>	M	M	See clause 11.5.1.6
Line Failure	07 <sub>16</sub>	M	M	See clause 11.5.1.7
CRC-8 Anomalies	08 <sub>16</sub>	M	M	See clause 11.5.1.8
OLR	09 <sub>16</sub>	M	M	See clause 11.5.1.9
Bitswap	0A <sub>16</sub>	M	M	See clause 11.5.1.10
Downstream Net Data Rate After Successful SRA	0B <sub>16</sub>	M	M	See clause 11.5.1.11
Upstream Net Data Rate After Successful SRA	0C <sub>16</sub>	M	M	See clause 11.5.1.12
Downstream Net Data Rate After Successful SOS	0D <sub>16</sub>	M	M	See clause 11.5.1.13
Upstream Net Data Rate After Successful SOS	0E <sub>16</sub>	M	M	See clause 11.5.1.14
Defect	0F <sub>16</sub>	M	M	See clause 11.5.1.15
Retransmission Event	10 <sub>16</sub>	M	M	See clause 11.5.1.16
Reserved for use by ITU-T	11 <sub>16</sub> to 7F <sub>16</sub>			
Vendor-discretionary event types	80 <sub>16</sub> to FF <sub>16</sub>			

NOTE – Event types that are optional in this Recommendation are mandatory for the data gathering function only if the particular event type is supported by the VTU.

#### 11.5.1.1 Event type "End of Showtime"

The event type "End of Showtime" shall occur when the VTU transitions from the SHOWTIME state to the SILENT state (see VTU-O state diagram in Figure 12-2 and VTU-R state diagram in Figure 12-3). The related event data shall identify the trigger issued at VTU-O or VTU-R for this transition.

Table 11-44 lists the event data, and the identifier that shall be used in the record to identify the event data. Table 11-44 also indicates whether the event data shall be supported by the VTU-O and/or VTU-R (M indicates "mandatory support" and RI1 indicates "mandatory only if  $Rlpolicy_n=1$ ".)

**Table 11-44 – Event data for event type "End of Showtime"**

Event data	ID	VTU-O	VTU-R	Definition
Reserved for future use	00 <sub>16</sub>			
VTU-O host triggered re-initialization	01 <sub>16</sub>	M	M	L3_request and L3_grant in Figure 12-2
VTU-R host triggered re-initialization	02 <sub>16</sub>	M	M	L3_request and L3_grant in Figure 12-3
Persistent ne-LOS	03 <sub>16</sub>	M	M	See clause 12.1.4
Persistent ne-LOF	04 <sub>16</sub>	M	M	See clause 12.1.4
Contiguous ne-SES	05 <sub>16</sub>	M	M	See Table 12-4 (Note 2)
Persistent ne-LOM	06 <sub>16</sub>	M	M	See clause 12.1.4
Persistent ne-TPS-TC out-of-sync	07 <sub>16</sub>	M	M	See clause 12.1.4
MAX-SOS	08 <sub>16</sub>	M	M	See Table 12-3
SOS rate low timeout	09 <sub>16</sub>	M	M	See Table 12-3
EOC no response	0A <sub>16</sub>	M	M	See Table 12-3
Other vendor specific VTU-O or VTU-R near-end conditions declaring a high_BER event	0B <sub>16</sub>	M	M	See Table 12-3 (Note 1)
Other vendor specific VTU-O or VTU-R far-end conditions declaring a high_BER event	0C <sub>16</sub>	M	M	See Table 12-3 (Note 1)
High BER-hs event as defined for $Rlpolicy_n=1$	0D <sub>16</sub>	RI1	RI1	See Table 12-4
Reserved for use by ITU-T	0E <sub>16</sub> to FF <sub>16</sub>			
NOTE 1 – This event data ID shall only be used with $Rlpolicy_n = 0$ .				
NOTE 2 – Only if $Rlpolicy_n=1$ , Table 12-4 defines this event data, otherwise it is vendor specific.				

### 11.5.1.2 Event type "Previous End of Showtime"

The event type "Previous End of Showtime" shall occur when the VTU enters the SHOWTIME state (see VTU-O state diagram in Figure 12-2 and VTU-R state diagram in Figure 12-3) and the VTU-R has an initialization flag set to 1 (see clause 11.2.3.6). The purpose of this event is to indicate that the previous end of showtime was due to a power cycle or host reinit at the VTU-R. This is important because the VTU-R's timestamp is reset when either of these actions occurs. The related event data shall represent the initialization flag set at the VTU-R (PLPR and PHPR as indicated by the VTU-R in the inventory commands and response, see clause 11.2.3.6).

Table 11-45 lists the event data, and the identifier that shall be used in the record to identify the event data. Table 11-45 also indicates whether the event data shall be supported by the VTU-O and/or VTU-R (M indicates "mandatory support" and NA indicates "not applicable").

**Table 11-45 – Event data for event type "Previous End of Showtime"**

Event data	ID	VTU-O	VTU-R	Definition
Reserved for future use	0016			
Previous-loss-of-power (PLPR)	0116	NA	M	See clause 11.2.3.6
Previous-host-reinit (PHRI)	0216	NA	M	See clause 11.2.3.6
Reserved for use by ITU-T	0316 to FF16			
NOTE – The timestamp for this Event Type is recorded immediately after the VTU-R is re-initialized.				

### 11.5.1.3 Event type "Failed Init"

The event type "Failed Init" shall occur when the VTU transitions from the INIT/TRAIN or INIT/HS state to the SILENT state (see VTU-O state diagram in Figure 12-2 and VTU-R state diagram in Figure 12-3). The related event data shall identify the last initialization phase the VTU-O or VTU-R entered before the initialization failed, e.g., Channel Discovery Phase.

Table 11-46 lists the event data, and the identifier that shall be used in the record to identify the event data. Table 11-46 also indicates whether the event data shall be supported by the VTU-O and/or VTU-R (M indicates "mandatory support"). The octet specifying the event data for this event type is split in half, with the four MSB defining in which phase the initialization failed, and the four LSB specifying the initialization failure cause. The initialization failure cause shall be as defined in clause 7.5.1.6 of [ITU-T G.997.1] and shall be coded as a 4-bit unsigned integer (as shown in Table 11-45).

**Table 11-46 – Event data for event type "Failed Init"**

Event data	Four MSB of ID	VTU-O	VTU-R	Definition
Reserved for use by ITU-T	0 <sub>16</sub>			
ITU-T G.994.1 phase	1 <sub>16</sub>	M	M	See Figure 12-5
Channel Discovery phase	2 <sub>16</sub>	M	M	See Figure 12-5
Training phase	3 <sub>16</sub>	M	M	See Figure 12-5
Channel Analysis and Exchange phase	4 <sub>16</sub>	M	M	See Figure 12-5
Reserved for future use	5 <sub>16</sub> to F <sub>16</sub>			
Event data	Four LSB of ID	VTU-O	VTU-R	Definition
Successful	0 <sub>16</sub>	M	M	See clause 7.5.1.6 of [ITU-T G.997.1]
Configuration error	1 <sub>16</sub>	M	M	See clause 7.5.1.6 of [ITU-T G.997.1]
Configuration not feasible on the line	2 <sub>16</sub>	M	M	See clause 7.5.1.6 of [ITU-T G.997.1]
Communication problem	3 <sub>16</sub>	M	M	See clause 7.5.1.6 of [ITU-T G.997.1]
No peer xTU detected	4 <sub>16</sub>	M	M	See clause 7.5.1.6 of [ITU-T G.997.1]
Any other or unknown initialization failure cause	5 <sub>16</sub>	M	M	See clause 7.5.1.6 of [ITU-T G.997.1]

**Table 11-46 – Event data for event type "Failed Init"**

Event data	Four LSB of ID	VTU-O	VTU-R	Definition
ITU-T G.998.4 retransmission mode was not selected while RTX_MODE = FORCED or with RTX_MODE = RTX_TESTMODE	6 <sub>16</sub>	M	M	See clause 7.5.1.6 of [ITU-T G.997.1]
Reserved for use by ITU-T	7 <sub>16</sub> to F <sub>16</sub>			

#### 11.5.1.4 Event type "Successful Init"

The event type "Successful Init" shall occur when the VTU transitions from the INIT/TRAIN to the SHOWTIME state (see VTU-O state diagram in Figure 12-2 and VTU-R state diagram in Figure 12-3). The related event data shall be the number of the bit to be set in xTU Transmission System Enabling (XTSE) as defined in clause 7.3.1.1.1 of [ITU-T G.997.1] for the representation of the transmission system type. For example, Event Data = 39<sub>16</sub> (57 decimal) is ITU-T G.993.2 Region A (North America) (Annex A).

Table 11-47 lists the event data, and the identifier that shall be used in the record to identify the event data. Table 11-47 also indicates whether the event data shall be supported by the VTU-O and/or VTU-R (M indicates "mandatory support").

**Table 11-47 – Event data for event type "Successful Init"**

Event data	ID	VTU-O	VTU-R	Definition
Reserved for use by ITU-T	00 <sub>16</sub>			
Transmission system type	01 <sub>16</sub> to 40 <sub>16</sub>	M	M	
Reserved for use by ITU-T	41 <sub>16</sub> to FF <sub>16</sub>			
NOTE – This event may be used to correlate the timestamps in the VTU-O and VTU-R buffers.				

#### 11.5.1.5 Event type "Downstream Init Net Data Rate"

The event type "Downstream Init Net Data Rate" shall occur when the VTU transitions from the INIT/TRAIN to the SHOWTIME state (see VTU-O state diagram in Figure 12-2 and VTU-R state diagram in Figure 12-3). The related event data shall identify the downstream net data rate applicable at the instant of entry into SHOWTIME.

The Downstream Init Net Data Rate (NDR) shall be recorded in the Event Data as an index, represented as an unsigned single octet integer, which shall be the integer value closest to:

$$63 \times \log_{10} \left( \frac{NDR}{0.2 \text{ Mbit/s}} \right) + 1, \text{ with } 1 \leq \text{index} \leq 253 \text{ for } 0.2 \text{ Mbit/s} \leq NDR \leq 2000 \text{ Mbit/s}.$$

If  $NDR \leq 0.2 \text{ Mbit/s}$ , then the index shall be 0. If  $NDR \geq 2000 \text{ Mbit/s}$ , then index shall be 254. The index value 255 shall be reserved.

NOTE – This results in 3.7% granularity between recordable downstream net data rates.

#### 11.5.1.6 Event type "Upstream Init Net Data Rate"

The Event Type "Upstream Init Net Data Rate" shall occur when the VTU transitions from the INIT/TRAIN to the SHOWTIME state (see VTU-O state diagram in Figure 12-2 and VTU-R state diagram in Figure 12-3). The related Event Data shall identify the upstream net data rate applicable at the instant of entry into SHOWTIME.

The Upstream Init Net Data Rate shall be recorded in the Event Data in the same way as the Downstream Init Net Data Rate (see clause 11.5.1.5).

### 11.5.1.7 Event type "Line Failure"

The event type "Line Failure" shall occur every time instant when one or more of near-end Line Failures occurs or terminates (see Table 7-10 of [ITU-T G.997.1]). These line failures may or may not result in a retrain. The related event data shall consist of a bitmap identifying each of the line failures, which can simultaneously record multiple types of Line failures. The event data indicates whether each line failure initially occurs or terminates in the reported second. If there are no line failures occurring or terminating in this second, then this event is not recorded.

Line failures are generated by the ITU-T G.997.1 functionality (see Figure 7-1 of [ITU-T G.997.1]). Therefore, the data gathering functionality gathers records from both the transceiver functionality and the ITU-T G.997.1 functionality.

Table 11-48 lists the Event Data, and the identifier that shall be used in the record to identify the Event Data. Table 11-48 also indicates whether the event data shall be supported by the VTU-O and/or VTU-R (M indicates "mandatory support").

**Table 11-48 – Event data for event type "Line Failure"**

Event Data	ID	VTU-O	VTU-R	Definition
LOS occurs	0 0 x x x x 1	M	M	See clause 7.1.1.1.1 of [ITU-T G.997.1]
LOS terminates	0 0 x x x x 1 x	M	M	See clause 7.1.1.2.1 of [ITU-T G.997.1]
LOF occurs	0 0 x x x 1 x x	M	M	See clause 7.1.1.1.2 of [ITU-T G.997.1]
LOF terminates	0 0 x x 1 x x x	M	M	See clause 7.1.1.2.2 of [ITU-T G.997.1]
LPR occurs	0 0 x 1 x x x x	M	M	See clause 7.1.1.1.3 of [ITU-T G.997.1]
LPR terminates	0 0 1 x x x x x	M	M	See clause 7.1.1.2.3 of [ITU-T G.997.1]
NOTE – Event Data denoted by "occurs" indicate the first occurrence of the event in a contiguous series.				

### 11.5.1.8 Event type "CRC-8 Anomalies"

The event type "CRC-8 Anomaly" records one or more contiguous seconds with CRC-8 anomalies at the near-end (see clause 9.5.2.3). The Event Data shall consist of a bitmap identifying the start and end of the CRC-8 anomalies at the near-end, which can simultaneously record multiple CRC-8 starting and ending events. For this Event Type; event data "1 or more CRC-8s anomalies per second started" shall occur at the first occurrence of a contiguous series of seconds with one or more CRC-8 anomalies; event data "1 or more CRC-8s anomalies per second ended" shall occur in the second immediately following the last occurrence of a contiguous series of seconds with one or more CRC-8 anomalies; event data "18 or more normalized CRC-8s anomalies per second started" shall occur at the first occurrence of a contiguous series of seconds with 18 or more normalized CRC-8 anomalies; and event data "18 or more normalized CRC-8s anomalies per second ended" shall occur in the second immediately following the last occurrence of a contiguous series of seconds with 18 or more normalized CRC-8 anomalies.

Table 11-49 lists the event data, and the identifier that shall be used in the record to identify the event data. Table 11-49 also indicates whether the Event Data shall be supported by the VTU-O and/or VTU-R (M indicates "mandatory support").

**Table 11-49 – Event data for event type "CRC-8 Anomalies"**

Event data	ID	VTU-O	VTU-R	Definition
One or more CRC-8s anomalies per second starts	0 0 0 0 x x 0 1	M	M	See clause 9.5.2.3
One or more CRC-8s anomalies per second ended	0 0 0 0 x x 1 0	M	M	See clause 9.5.2.3
18 or more normalized CRC-8s anomalies per second starts	0 0 0 0 0 1 x x	M	M	See clause 9.5.2.3
18 or more normalized CRC-8s anomalies per second ended	0 0 0 0 1 0 x x	M	M	See clause 9.5.2.3
NOTE – One or more CRC-8 anomalies per second is one possible cause of an ES-L (see clause 7.2.1.1.2 of [ITU-T G.997.1]). 18 or more normalized CRC-8 anomalies per second is one possible cause of an SES-L (see clause 7.2.1.1.3 of [ITU-T G.997.1]).				

#### 11.5.1.9 Event type "OLR"

The Event Type "OLR" shall occur when a (sent or received) OLR command is deferred, rejected, or positively acknowledged (i.e., successful) (see clause 13.1) and when no response to a sent OLR command is received within the specified time period (i.e., failed) (see Table 11-1). The related event data shall identify the result of the OLR procedure. Table 11-50 lists the event data, and the identifier that shall be used in the record to identify the Event Data. If there is one or more events with a given event data in this second, then the indicator bit corresponding to that event data is set to 1; the indicator bit is set to 0 otherwise. Multiple instances of different event data for this event that occur during the same second shall be recorded by setting multiple indicator bits to 1 as indicated in Table 11-50.

Table 11-50 also indicates whether the event data shall be supported by the VTU-O and/or VTU-R (M indicates "mandatory support").

**Table 11-50 – Event data for event type "OLR"**

Event data	ID	VTU-O	VTU-R	Definition
Successful SRA downstream	x x x x x x x 1	M	M	See clause 13.1
Failed, deferred, or rejected SRA downstream	x x x x x x 1 x	M (see Note 1)	M	See clause 13.1
Successful SRA upstream	x x x x x 1 x x	M	M	See clause 13.1
Failed, deferred, or rejected SRA upstream	x x x x 1 x x x	M	M (see Note 1)	See clause 13.1
Successful SOS downstream	x x x 1 x x x x	M	M	See clause 13.1
Failed, deferred, or rejected SOS downstream	x x 1 x x x x x	M (see Note 1)	M	See clause 13.1

**Table 11-50 – Event data for event type "OLR"**

<b>Event data</b>	<b>ID</b>	<b>VTU-O</b>	<b>VTU-R</b>	<b>Definition</b>
Successful SOS upstream	x 1 x x x x x x	M	M	See clause 13.1
Failed, deferred, or rejected SOS upstream	1 x x x x x x x	M	M (see Note 1)	See clause 13.1
NOTE 1 – A failed event would not be recorded in this case.				
NOTE 2 – Event types that are optional in this Recommendation are mandatory for the data gathering function only if the particular event type is supported by the VTU.				

**11.5.1.10 Event type "Bitswap"**

The event type "Bitswap" shall occur when a bitswap command is deferred, rejected, or positively acknowledged (i.e., successful), (see clause 13.1) and when no response to a sent bit swapping command is received within the specified time period (i.e., failed) (see Table 11-1). The related event data as per Table 11-51 shall identify the result of the bit swapping procedure.

If a particular bitswap event data occurs at least once, then the bit corresponding to the Bitswap event data in Table 11-51 shall be set to "1". If a particular bitswap event data did not occur, then the bit corresponding to the Bitswap event data in Table 11-51 shall be set to "0". The two highest MSB of the ID shall indicate the number of occurrences of this event during this second, i.e., one event, two events, and more than two events. Multiple instances of this event that occur in the same second shall be recorded simultaneously in a single record using the first two bits of the event data ID to record the total number of Bitswap events. Table 11-51 lists the event data, and the identifier that shall be used in the record to identify the event data. Table 11-51 also indicates whether the event data shall be supported by the VTU-O and/or VTU-R (M indicates "mandatory support").

**Table 11-51 – Event data for event type "Bitswap"**

<b>Event data</b>	<b>Two MSB of ID</b>	<b>VTU-O</b>	<b>VTU-R</b>	<b>Definition</b>
Number of Bitswap events	0 1	M	M	1 = Number of Bitswap events
	1 0	M	M	2 = Number of Bitswap events
	1 1	M	M	3 = More than two Bitswap events
	<b>Six LSB of ID</b>	<b>VTU-O</b>	<b>VTU-R</b>	<b>Definition</b>
<b>Event data</b>				
Successful bitswap downstream	x x x x x 1	M	M	See clause 13.1
Failed, deferred or rejected bitswap downstream	x x x x 1 x	M (see Note)	M	See clause 13.1
Successful bitswap upstream	x x x 1 x x	M	M	See clause 13.1
Failed, deferred or rejected bitswap upstream	x x 1 x x x	M	M (see Note)	See clause 13.1
NOTE – A failed bitswap would not be recorded in this case.				

#### **11.5.1.11 Event type "Downstream Net Data Rate after Successful SRA"**

The event type "Downstream Net Data Rate after Successful SRA" shall occur when a downstream SRA request is positively acknowledged (i.e., successful). The related event data shall identify the downstream net data rate applicable at the completion of the SRA procedure.

The Downstream Net Data Rate after Successful SRA shall be recorded in the event data in the same way as the Downstream Init Net Data Rate (see clause 11.5.1.5).

#### **11.5.1.12 Event type "Upstream Net Data Rate after Successful SRA"**

The Event Type "Upstream Net Data Rate after Successful SRA" shall occur when an upstream SRA request is positively acknowledged (i.e., successful). The related event data shall identify the upstream net data rate applicable at the completion of the SRA procedure.

The Upstream Net Data Rate after Successful SRA shall be recorded in the event data in the same way as the Downstream Init Net Data Rate (see clause 11.5.1.5).

#### **11.5.1.13 Event type "Downstream Net Data Rate after Successful SOS"**

The event type "Downstream Net Data Rate after Successful SOS" shall occur when a downstream SOS request is positively acknowledged (i.e., successful). The related event data shall identify the downstream net data rate applicable at the completion of the SOS procedure.

The Downstream Net Data Rate after Successful SOS shall be recorded in the Event Data in the same way as the Downstream Init Net Data Rate (see clause 11.5.1.5).

#### **11.5.1.14 Event type "Upstream Net Data Rate after Successful SOS"**

The event type "Upstream Net Data Rate after Successful SOS" shall occur when an upstream SOS request is positively acknowledged. The related event data shall identify the upstream net data rate applicable at the completion of the SOS procedure.

The Upstream Net Data Rate after Successful SOS shall be recorded in the Event Data in the same way as the Downstream Init Net Data Rate (see clause 11.5.1.5).

#### **11.5.1.15 Event type "Defect"**

If a *los*, *lom*, or *sef* defect (see clauses 11.3.1.3 and 11.3.1.4) occurs during any part of a second, then that second is considered to be a *los* defected second, a *lom* defected second, or a *sef* defected second, respectively. The event type "Defect" shall occur each second when any type of defected second starts or ended. A type of defected second shall be recorded as "starts" when that type of defected second occurs in the current second but did not occur in the previous second. A type of defected second shall be recorded as having "ended" when that type of defected second occurred in the previous second but does not occur in the current second. A particular type of defected second (*los* defected second, *lom* defected second, or *sef* defected second) cannot both start and stop in the same second. In order to gather multiple types of defected second events in one record, The event data shall consist of a bitmap identifying the start and end each of each type of defected second.

Table 11-52 lists the event data, and the identifier that shall be used in the event record to identify the event data. Table 11-52 also indicates whether the event data shall be supported by the VTU-O and/or VTU-R (M indicates "mandatory support" and "NA" indicates "not applicable").

**Table 11-52 – Event data for event type "Defect"**

Event data	ID	VTU-O	VTU-R	Definition
<i>los</i> second starts	x x x x x 0 1	M	M	See clause 11.3.1.3
<i>los</i> second ended	x x x x x 1 0	M	M	See clause 11.3.1.3
<i>lom</i> second starts	x x x x 0 1 x x	M	M	See clause 11.3.1.3
<i>lom</i> second ended	x x x x 1 0 x x	M	M	See clause 11.3.1.3
<i>sef</i> second starts	x x 0 1 x x x x	M	M	See clause 11.3.1.3
<i>sef</i> second ended	x x 1 0 x x x x	M	M	See clause 11.3.1.3

### 11.5.1.16 Event type "Retransmission Event"

The event type "Retransmission Event" shall occur when the VTU operates in ITU-T G.998.4 (retransmission) mode and one of the retransmission events (see Table 11-53) occurs. The related event data shall identify the retransmission event that occurred.

Table 11-53 lists the event data, and the identifier that shall be used in the record to identify the event data. Table 11-53 also indicates whether the event data shall be supported by the VTU-O and/or VTU-R (M indicates "mandatory support").

**Table 11-53 – Event data for event type "Retransmission Event"**

Event data	ID	VTU-O	VTU-R	Definition
Reserved for future use	00 <sub>16</sub>			
<i>leftr</i> defect	01 <sub>16</sub>	M	M	See clause 11.3.3 of [ITU-T G.998.4]
Reserved for use by ITU-T	02 <sub>16</sub> to FF <sub>16</sub>			
NOTE – The <i>leftr</i> defect is recorded only for upstream at the VTU-O, and it is reported only for downstream at the VTU-R. This is because the <i>leftr</i> defect is near-end only.				

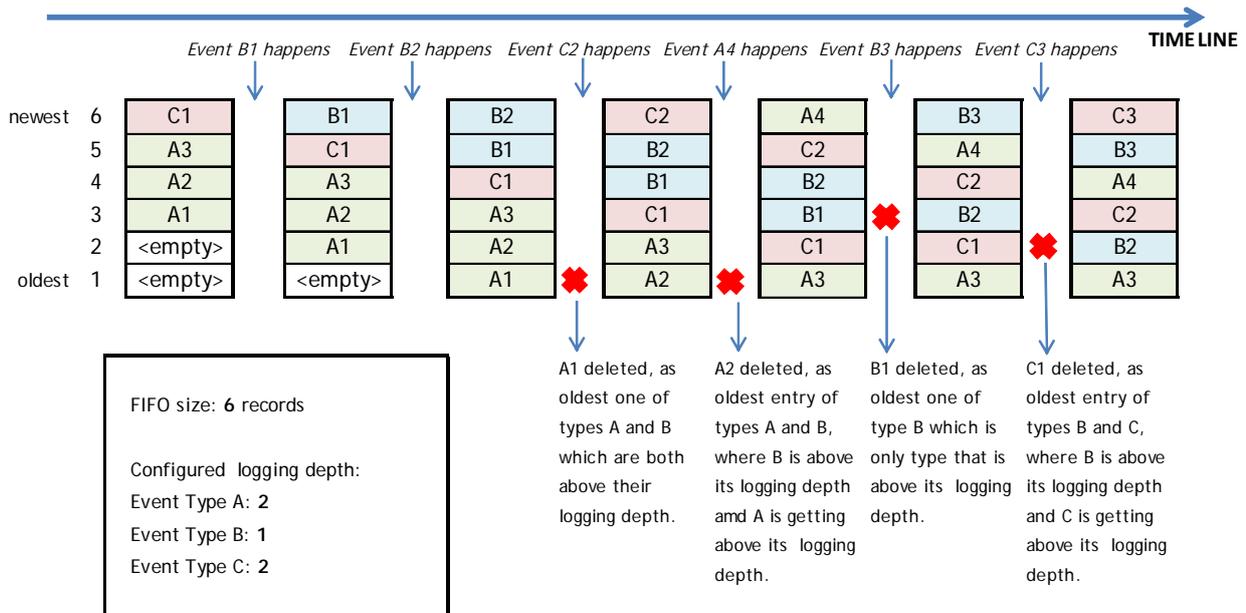
### 11.5.2 Buffer management rules

In order to obtain a fair mixing of event types in the buffer, while guaranteeing that the oldest entries per event type are removed first, following buffer management rules shall apply:

- The sum of the configured logging depths, *logging\_depth\_event<sub>i</sub>*, over all event types shall be smaller than or equal to the number of storable records in the buffer, *logging\_depth*.
- When the buffer is not yet full, a new entry can be added without constraints.
- When the buffer is full, before adding a new entry, one entry shall be removed. The entry that shall be removed is the oldest entry out of all event types which are already above their configured logging depths or which would get above their configured logging depths if the new entry was to be added without a removal.

NOTE – The third rule is described as a "remove before add". It can also be rephrased as "remove after add" as follows: "when the buffer is full, the new entry is added to a spare location. The entry that shall be removed is the oldest entry out of all event types which are above their configured logging depths."

These buffer management rules are illustrated in Figure 11-6.



**Figure 11-6 – Illustration of the buffer management rules.**

**2.2) Clause 11.2.3.2**

Add a row at the end of Table 11-5 in clause 11.2.3.2 as follows:

**11.2.3.2 Command and response types**

**Table 11-5 – Low priority commands and responses**

Command type and assigned value	Direction of command	Command content	Response content	Support
...	...	...	...	...
Data gathering 1100 1100 <sub>2</sub>	From VTU-O to VTU-R	Configure data gathering or request a number of data gathering records	ACK/NACK the data gathering configuration or transfer data gathering records	Optional

**2.3) Clause 11.2.3.16**

Add new clause 11.2.3.16 as follows:

**11.2.3.16 Data gathering commands and responses**

This clause defines the commands and responses to support the data gathering function defined in clause 11.5. If the VTU-R supports the data gathering function, then the VTU-R shall keep a buffer of data gathering records, with each data gathering record relating to one of the event types listed in Table 11-43. Data gathering records shall be transmitted from the VTU-R to the VTU-O in eoc messages upon request of the VTU-O. The VTU-O sends a data gathering command (to configure data gathering or to request a number of data gathering records, see Table 11-40.1). The VTU-R shall respond with a data gathering response (to ACK/NACK the data gathering configuration or to transfer data gathering records, see Table 11-40.2). The VTU-O shall acknowledge (ACK) the response and may simultaneously request more data gathering records. The VTU-R buffer shall be

transferred to the VTU-O through a sequence of command and response messages until all records in the VTU-R buffer, up to *act\_logging\_depth\_reporting\_R* records, are reported.

**Table 11-40.1 – Data gathering commands sent by the VTU-O**

Name	Length (Octets)	Octet number	Content
Configure data gathering		2	00 <sub>16</sub>
		3-4	<i>act_logging_depth_reporting_R</i>
		5	<i>logging_reporting_newer_first</i>
		6	number of event types configured ( <i>Ntyp</i> )
		7	<i>logging_depth_event_percentage_R_1</i>
		...	...
		7+ <i>Ntyp</i>	<i>logging_depth_event_percentage_R_Ntyp</i>
Request data-gathering records	1	2	01 <sub>16</sub>
	1	3	ACK_ID
	1	4	Sequence_ID
	1	5	Number of event records to report in response message ( <i>Nreq</i> )

**Table 11-40.2 – Data gathering response sent by the VTU-R**

Name	Length (Octets)	Octet number	Content
Configure data gathering ACK	4	4 5-6	80 <sub>16</sub> <i>logging_depth_R</i>
Configure data gathering NACK	4	4 5-6	81 <sub>16</sub> <i>logging_depth_R</i>
Response with data-gathering records	10 (if <i>Nrep</i> =0) up to 778 (if <i>Nrep</i> =128)	2 3 4-7 8-9 10 11 ... 10+6× <i>Nrep</i>	90 <sub>16</sub> Sequence_ID Current VTU-R timestamp Number of event records in the buffer not yet ACKed ( <i>Nnack</i> ) Number of event records reported in this message ( <i>Nrep</i> ) 6× <i>Nrep</i> octets with the data gathering records

#### 11.2.3.16.1 Data gathering configuration

The control parameter *act\_logging\_depth\_reporting\_R* is defined in clause 11.5. The control parameter *logging\_report\_newer\_first* indicates the order in which the VTU-R shall report the records in the VTU-R buffer. If set to TRUE, then the VTU-R shall report the record related to the most recent event first. If set to FALSE, then the VTU-R shall report the record related to the least recent event first. The control parameter *logging\_report\_newer\_first* shall have a value equal to the

CO-MIB configuration parameter `LOGGING_REPORT_NEWER_FIRST` (see clause 7.3.6.5 of [ITU-T G.997.1]).

The control parameters *logging\_depth\_event\_percentage<sub>R<sub>i</sub></sub>* are defined in clause 11.5. The *logging\_depth\_event\_percentage<sub>R<sub>i</sub></sub>* is configured for event type ID = 1 up to event type ID = *Ntyp*, with event type IDs as listed in Table 11-43. For all event types with ID > *Ntyp*, the VTU-R shall set *logging\_depth\_event\_percentage<sub>R<sub>i</sub></sub>* = 0.

If the VTU-R supports the last received data gathering configuration, then the VTU-R shall send a configure data gathering ACK response. If the VTU-R does not support the last received data gathering configuration (e.g., because *act\_logging\_depth\_reporting<sub>R</sub>* is higher than *logging\_depth<sub>R</sub>*), then the VTU-R shall send a configure data gathering NACK response. Upon sending an ACK, the VTU-R shall apply the last received data gathering configuration. Upon receiving a NACK, the VTU-O shall send a new configure data gathering command.

If a new data gathering configuration is applied with an *act\_logging\_depth\_reporting<sub>R</sub>* larger than or equal to the actual number of records in the VTU-R buffer, then existing records shall stay in the VTU-R buffer. Otherwise, the VTU-R may apply a vendor discretionary method (including reset of the entire VTU-R buffer) to discard records in the buffer.

If a new data gathering configuration is applied with an *act\_logging\_depth\_reporting<sub>O</sub>* larger than or equal to the actual number of records in the VTU-O buffer, then existing records shall stay in the VTU-O buffer. Otherwise, the VTU-O may apply a vendor discretionary method (including reset of the entire VTU-O buffer) to discard records in the buffer.

#### **11.2.3.16.2 Transfer of the VTU-R buffer from the VTU-R to the VTU-O**

The VTU-R buffer is transferred to the VTU-O through a sequence of command and response messages until all records in the VTU-R buffer, up to *act\_logging\_depth\_reporting<sub>R</sub>* records, are reported.

The VTU-O allocates a sequence ID to each request data gathering records command message. The first command message in a sequence of command and response messages shall have `Sequence_ID` = 00<sub>16</sub>. If the response message to a command message is received by the VTU-O, then the next command message shall have the `Sequence_ID` incremented by one. If the response message to a command message is not received, then the next command message shall be a retransmission of the previous command message or a command message with `sequence_ID` = 00<sub>16</sub>. If a sequence of more than 128 command and response messages is needed to transfer the whole VTU-R buffer, then the `sequence_ID` following `sequence_ID` = 7F<sub>16</sub> shall be `sequence_ID` = 01<sub>16</sub>.

In the response with data gathering records message, the VTU-R shall copy the same `sequence_ID` allocated by the VTU-O to the request data gathering records command message.

In the command message with `Sequence_ID` = 00<sub>16</sub>, the VTU-O shall set the `ACK_ID` to 00<sub>16</sub>.

When receiving a command message with `Sequence_ID` = 00<sub>16</sub>, the VTU-R shall ignore the `ACK_ID` in this command message. Before sending a response message, the VTU-R shall mark all records in the VTU-R buffer (except dummy records) as "not yet ACKed". In the response message (with `Sequence_ID` = 00<sub>16</sub>), the value *Nnack* indicate the number of records in the VTU-R buffer. With a VTU-R buffer full condition, *Nnack* = *act\_logging\_depth\_reporting<sub>R</sub>*.

When receiving a command message with `Sequence_ID` > 00<sub>16</sub>, and before sending a response message, the VTU-R shall mark the set of records which were reported in the response message with `sequence_ID` equal to `ACK_ID` as having been ACKed. The VTU-R shall keep the ACKed records in the VTU-R buffer (i.e., not delete the ACKed records from the VTU-R buffer).

NOTE 1 – The records are not marked as ACKed until the `ACK_ID` is received because eoc messages (requests or responses) can get lost.

The command message shall include the number of records requested to be reported (*Nreq*). The value of *Nreq* shall be at most 128. If the VTU-O chooses to use multiple eoc command/response messages to transfer the whole VTU-R buffer, then the value of *Nreq* may be less than *act\_logging\_depth\_reporting\_R*.

The response message shall include the number of records stored in the VTU-R buffer that are not yet ACKed by the VTU-O (*Nnack*), so the VTU-O knows how many more records are to be transferred.

The response message shall include the number of records reported in the response message (*Nrep*). The value *Nrep* shall be the minimum of *Nreq* and *Nnack*. If *Nrep* < *Nreq*, then *Nrep* = *Nnack*. If all records in the VTU-R buffer have been ACKed, then *Nrep* = *Nnack* = 0.

If *logging\_report\_newer\_first* is FALSE, then the response message shall include the *Nrep* least recent records in the VTU-R buffer that have not yet been ACKed by the VTU-O. The response message shall include the *Nrep* records in ascending order of timestamp, with least recent record starting at octet 11.

If *logging\_report\_newer\_first* is TRUE, then the response message with *sequence\_ID* = 0 shall include the *Nrep* most recent records in the VTU-R buffer that have not yet been ACKed by the VTU-O. The response messages with *sequence\_ID* > 0 shall include the *Nrep* most recent records in the VTU-R buffer that have not yet been ACKed by the VTU-O and have a timestamp older than the timestamps of the records ACKed by the VTU-O in the command message. The response message shall include the *Nrep* records in descending order of timestamp, with most recent record starting at octet 11.

The response message includes the current VTU-R timestamp. This allows the VTU-O to offset the all the VTU-R timestamps with a fixed offset so that they are stored in the CO-MIB in the same NTP format, with nearly the same timing, as the VTU-O timestamps. This also limits the time error due to VTU-R clock drift to the accumulated error between the time the event is recorded and the time that it is transferred to the VTU-O.

Upon receiving the response message containing the last of *act\_logging\_depth\_reporting\_R* records to be transferred, or upon receiving a response message with *Nnack* = *Nrep*, the VTU-O shall send the last command message in the sequence of command and response messages that is an acknowledgement of the last transferred *Nrep* records, and has *Nreq* = 0, denoting no further records are to be transferred. Only in this last command message in a sequence of command and response messages shall *Nreq* = 0. All preceding command messages shall have *Nreq* > 0.

NOTE 2 – If no new records are generated at the VTU-R during the eoc transfer, then the entire VTU-R buffer is transferred to the VTU-O.

NOTE 3 – If new event records are generated at the VTU-R during the eoc transfer, leading to already transferred records being removed from the VTU-R buffer due to buffer management rules, and *logging\_report\_newer\_first* is FALSE, then the VTU-R buffer will not be entirely transferred to the VTU-O because *act\_logging\_depth\_reporting\_R* records will have been ACKed by the VTU-O while *Nnack* is still larger than zero at the VTU-R.

NOTE 4 – If new event records are generated at the VTU-R during the eoc transfer, leading to not yet transferred records being removed from the VTU-R buffer due to buffer management rules, and *logging\_report\_newer\_first* is TRUE, then the VTU-R buffer will not be entirely transferred to the VTU-O because *Nnack* will be zero at the VTU-R before *act\_logging\_depth\_reporting\_R* records have been ACKed by the VTU-O.

### 11.2.3.16.3 Write of the transferred VTU-R buffer to the CO-MIB

If *logging\_report\_newer\_first* is TRUE, then (see Notes 3, 4 and 5 below):

- When the VTU-O sends a data gathering command message with *sequence\_ID* = 00<sub>16</sub>, the VTU-O shall reset the *EVENT\_TRACE\_BUFFER\_R* to all zero values by setting all

records to be dummy records, where a dummy record is defined as a record which has all fields set to the value 0.

- The VTU-O shall write the block of records contained in the data gathering response message with `Sequence_ID = 0016` in the `EVENT_TRACE_BUFFER_R` in the locations corresponding to the most recent block of records.
- The VTU-O shall write blocks of records contained in subsequent data gathering response messages in the `EVENT_TRACE_BUFFER_R` in the locations corresponding to the next most recent block of records.
- The VTU-O may choose to update the `EVENT_TRACE_BUFFER_R` with every received data gathering response message, or may choose to update after having received several data gathering response messages.

NOTE 1 – Subsequent readings of the `EVENT_TRACE_BUFFER_R` over the Q-interface while a transfer of the VTU-R buffer is ongoing may show a steadily increasing number of records in the CO-MIB element.

- The order of the records in the `EVENT_TRACE_BUFFER_R` shall correspond to the order of the records inside a received data gathering response message (i.e., no re-ordering inside a block), and concatenated in the order of subsequently received data gathering response messages (i.e., no re-ordering of blocks).

If `logging_report_newer_first` is FALSE, then (see Notes 4 and 5 below):

- Then the VTU-O sends a data gathering command with `sequence_ID = 0016`, then the `EVENT_TRACE_BUFFER_R` is not reset.
- The VTU-O shall write the block of records contained in the data gathering response message with `Sequence_ID = 0016` in the `EVENT_TRACE_BUFFER_R` in the locations corresponding to the least recent block of records and thereby overwrite the existing records at those locations.
- The VTU-O shall write blocks of records contained in subsequent data gathering response messages in the `EVENT_TRACE_BUFFER_R` in the locations corresponding to the next least recent block of records and thereby overwrite the existing records at those locations.
- The VTU-O may choose to update the `EVENT_TRACE_BUFFER_R` with every received data gathering response message, or may choose to update after having received several data gathering response messages.

NOTE 2 – Subsequent readings of the `EVENT_TRACE_BUFFER_R` over the Q-interface while a transfer of the VTU-R buffer is ongoing may show some duplicate records.

- The order of the records in the `EVENT_TRACE_BUFFER_R` shall correspond to the order of the records inside a received data gathering response message (i.e., no re-ordering inside a block), and concatenated in the order of subsequently received data gathering response messages (i.e., no re-ordering of blocks).

NOTE 3 – Setting `logging_report_newer_first` to TRUE allows the rapid transfer of a relatively small number of recent event records with a relatively small number of data gathering commands.

NOTE 4 – If no new event records are generated at the VTU-R during the transfer of the VTU-R buffer, then the entire VTU-R buffer is transferred into `EVENT_TRACE_BUFFER_R`.

NOTE 5 – If new records are generated at the VTU-R during the transfer of the VTU-R buffer, then the CO-MIB parameter `EVENT_TRACE_BUFFER_R` may not contain some records that are present in the VTU-R buffer at the end of the transfer, may not contain some records that were present in the VTU-R buffer at the start of the transfer, and may contain records that are not present in the VTU-R buffer at the end of the transfer because of buffer management.

3) **Align with ITU-T G.997.1 VECTORMODE\_ENABLE**

3.1) **Clause 12.3.2.1.1**

Change clause 12.3.2.1.1 as follows:

**12.3.2.1.1 CL messages**

...

**Table 12-7 – VTU-O CL message NPar(2) bit definitions**

<b>ITU-T G.994.1 NPar(2) Bit</b>	<b>Definition of NPar(2) bit</b>
All-digital mode	If set to ONE, signifies that the VTU-O supports all-digital mode
Support of downstream virtual noise	If set to ONE, signifies that the VTU-O supports the use of the downstream virtual noise mechanism
Lineprobe	Always set to ONE in a VTU-O CL message
Loop Diagnostic mode	Set to ONE if the VTU-O requests loop diagnostic mode
Support of PSD shaping in US0	Always set to ONE in a VTU-O CL message
Support of equalized FEXT UPBO	If set to ONE, signifies that the VTU-O supports equalized FEXT UPBO
ITU-T G.993.5-friendly ITU-T G.993.2 operation in the downstream direction	<del>If set to ONE, signifies that VTU-O supports Annex N.</del> <u>See Annex N, Table N.1</u>
Full ITU-T G.993.5-friendly ITU-T G.993.2 operation	<del>If set to ONE, signifies that VTU-O supports Annex O.</del> <u>See Annex O, Table O.1</u>
Alternative electrical length estimation method	If set to ONE, signifies that the VTU-O supports the Alternative Electrical Length Estimation Method (ELE-M1)

3.2) **Clause N.2.1.1.1**

Change clause N.2.1.1.1 as follows:

**N.2.1.1.1 CL messages (supplements clause 12.3.2.1.1)**

...

**Table N.1 – VTU-O CL message NPar(2) bit definitions**

<b>ITU-T G.994.1 NPar(2) bit</b>	<b>Definition of NPar(2) bit</b>
ITU-T G.993.5-friendly ITU-T G.993.2 operation in the downstream direction	<u>This bit shall be set to ONE, if and only if the VTU-O supports Annex N and Annex N is allowed via the CO-MIB (i.e., VECTORMODE_ENABLE bit 1 is set to 1, see clause 7.3.1.13.9 of [ITU-T G.997.1]).</u> If set to ONE, indicates the capability of the VTU-O to comply with all requirements of this annex, including: <ul style="list-style-type: none"> <li>to send O-P-VECTOR-1 (as defined in [ITU-T G.993.5]) during initialization after O-P-QUIET and before O-P-CHANNEL DISCOVERY 1, and</li> </ul>

**Table N.1 – VTU-O CL message NPar(2) bit definitions**

ITU-T G.994.1 NPar(2) bit	Definition of NPar(2) bit
	<ul style="list-style-type: none"> <li>• to send O-P-VECTOR-1-1 (as defined in [ITU-T G.993.5]) during initialization after O-P-SYNCHRO 3 and before O-P-TRAINING 1, and</li> <li>• to send pilot sequences on the probe tones (as defined in [ITU-T G.993.5]) of the sync symbols during showtime</li> </ul> <p>If set to ONE, and the CO-MIB VECTORMODE_ENABLE bit 3 is set to 1 (see clause 7.3.1.13.9 of [ITU-T G.997.1]), then the ITU-T G.993.5 SPar(2) bit shall also be set to ONE.</p>

**3.3) Clause O.1.1.1.1**

*Change clause O.1.1.1.1 as follows:*

**O.1.1.1.1 CL messages (supplements clause 12.3.2.1.1 of ITU-T G.993.2)**

...

**Table O.1 – VTU-O CL message NPar(2) bit definitions**

ITU-T G.994.1 NPar(2) bit	Definition of NPar(2) bit
Full ITU-T G.993.5-friendly ITU-T G.993.2 operation	<p><u>This bit shall be set to ONE, if and only if the VTU-O supports Annex O and Annex O is allowed via the CO-MIB (i.e., VECTORMODE_ENABLE bit 2 is set to 1, see clause 7.3.1.13.9 of [ITU-T G.997.1])</u></p> <p>If set to ONE, indicates that the VTU-O supports compliance with this annex (full ITU-T G.993.5 friendly ITU-T G.993.2 operation).</p> <p>If set to ONE, and the CO-MIB VECTORMODE_ENABLE bit 3 is set to 1 (see clause 7.3.1.13.9 of [ITU-T G.997.1]), both the ITU-T G.993.5 SPar(2) bit and the related "Upstream vectoring" NPar(3) bit shall also be set to ONE.</p>

**4) Loop diagnostic mode procedures in Annex O**

**4.1) Clause O.7**

*Add new clause O.7*

**O.7 Loop diagnostic mode procedures (replaces clause 12.4)**

The loop diagnostic mode procedure is identical to the ITU-T G.993.5 loop diagnostic mode procedure.





## **SERIES OF ITU-T RECOMMENDATIONS**

Series A	Organization of the work of ITU-T
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
<b>Series G</b>	<b>Transmission systems and media, digital systems and networks</b>
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Terminals and subjective and objective assessment methods
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects and next-generation networks
Series Z	Languages and general software aspects for telecommunication systems