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ITU-T

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G.993.5

Corrigendum 1

(06/2011)

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

Digital sections and digital line system – Access networks

Self-FEXT cancellation (vectoring) for use with VDSL2 transceivers

Corrigendum 1

Recommendation ITU-T G.993.5 (2010) – Corrigendum 1

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Recommendation ITU-T G.993.5

Self-FEXT cancellation (vectoring) for use with VDSL2 transceivers

Corrigendum 1

Summary

Corrigendum 1 to Recommendation ITU-T G.993.5 (2010) includes:

- Addition of an (informative) note to clause 9.2 related to the fast update mechanism.
- Several corrections for clarity and consistency of wording.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T G.993.5	2010-04-22	15
1.1	ITU-T G.993.5 (2010) Cor. 1	2011-06-22	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.

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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.

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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/.

Recommendation ITU-T G.993.5

Self-FEXT cancellation (vectoring) for use with VDSL2 transceivers

Corrigendum 1

1) Scope

Corrigendum 1 to Recommendation ITU-T G.993.5 (2010) includes:

- Addition of an (informative) note to clause 9.2 related to the fast update mechanism.
- Several corrections for clarity and consistency of wording.

2) Abbreviations

Add the following abbreviation to clause 4:

DSE Disorderly Shutdown Event

3) Changes in clause 7.2.3.1, "Format of the ERB"

Change the text of the second paragraph as follows:

The format of the VBB is presented in Figure 7-7. Each VBB starts from an 8-bit VBB_ID field, followed by a VBB_Aux field, followed by concatenated error blocks, and ends with a pad of 0, 2, 4 or 6 bits to fit the length of the VBB to an integer number of bytes (odd number of padding bits is not applicable). The three MSBs of the VBB_ID field shall include the number of the vectored band (000 for VBB-0, 001 for VBB-1, … up to 111 for VBB-7). The ~~nine~~five LSBs of the VBB_ID field shall be set to '0' and be reserved for ITU-T. The error blocks shall be concatenated in a VBB in ascending order: the first block inside the vectored band is the one that contains clipped error samples for sub-carriers with lowest indices and shall be transmitted first.

4) Changes in clause 7.4.1, "Layer 2 Ethernet encapsulation of the backchannel data"

Change the text of this clause as follows:

If the VCE selects to use this encapsulation type, the backchannel data shall be encapsulated as defined in this clause.

Within the NT, the clipped error samples are first sent from the VTU-R to the L2+ functional block, where they are encapsulated into the layer 2 transport protocol and multiplexed into one of the upstream Ethernet (or Ethernet over ATM) data streams.

Ethernet encapsulation is based on [IEEE 802.3] and shall be as described in this clause.

The Layer 2 Ethernet frame encapsulation shall consist of the following fields:

– Destination MAC address shall be MAC address of the VCE;
– Source MAC address shall be the MAC address of the VTU-R;
– Length field (as per the IEEE 802.3 MAC frame format [IEEE 802.3]);
– LLC PDU header coding for SNAP protocol (3 bytes, AA-AA-03);
– SNAP PDU header containing a 3-octet ITU OUI 00-19-A7 + 2-octet Protocol ID of ITU subtype 00-03 for a PRIVATE protocol;
– Protocol Payload Data (Line_ID, Sync Symbol Count, Segment Code and Backchannel Data);

– Padding (only for the last segment and as per the IEEE 802.3 MAC frame format [IEEE 802.3]);

– Standard Ethernet 4-byte FCS (as per the IEEE 802.3 Ethernet frame FCS [IEEE 802.3]).

The VCE MAC Address field shall contain the VCE MAC Address as configured by the VCE through O-PMS, see clause 10.5.2.1. The protocol payload data shall contain the Line_ID (as configured by the VCE through O-PMS, see clause 10.5.2.1), the Sync Symbol Count (as defined in clause 7.2.4), the Segment Code (as defined in [ITU-T G.993.2]) and the backchannel data ERB (as defined in clause 7.2.3). The Length field shall equal the length of the protocol payload data, increased with the 8-byte LLC SNAP header length, and shall not exceed 1024 + 8 = 1032. If the protocol payload data exceeds 1024 bytes, the backchannel data ERB shall be segmented as defined in clause 11.2.3.1 of [ITU-T G.993.2]. For protocol payload data lengths shorter than or equal to 1024 bytes, the backchannel data ERB may also be segmented. If segmented, each segment of the backchannel data ERB shall be Layer 2 Ethernet encapsulated as shown in Figure 7-9, with the number of segments per backchannel data ERB not exceeding 16.

The format of the Ethernet encapsulated backchannel data ERB is shown in Figure 7-9.

Replace Figure 7.9 with the following:

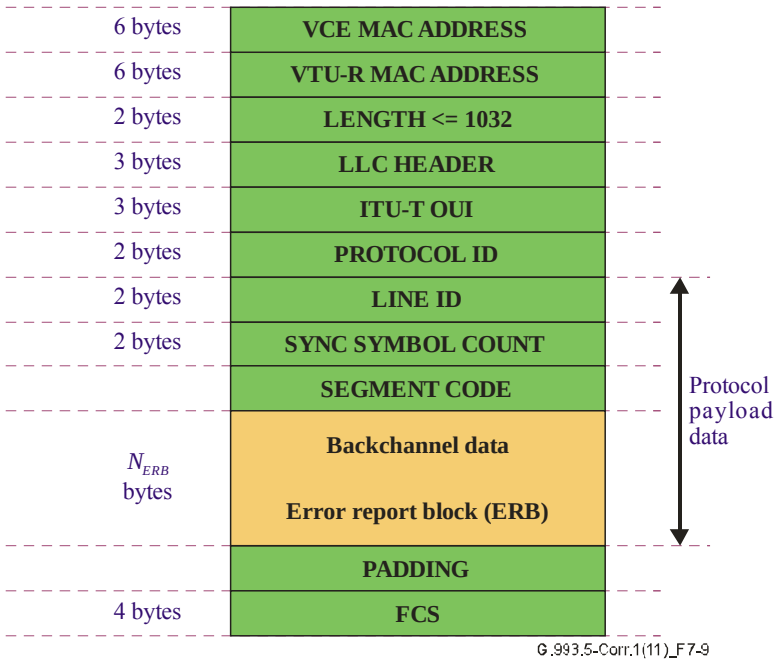

Figure 7-9 – Format of the Ethernet encapsulation of backchannel data message

5) Changes in clause 8.1, "EOC messages for backchannel configuration"

Change the value of Length (octets) in Table 8-3 as follows:

~~6~~9 + 5 × N_band (N_band ≤ 8)

6) Changes in clause 9.2, "Disorderly shutdown event"

Change the text as follows:

In the case of detection of ~~far~~near-end loss of ~~power~~signal primitive ~~*flpr*~~*los* (see clause 11.3.1.3~~.2~~ of [ITU-T G.993.2]), it is recommended that the VTU-O switches off its transmit signal as soon as possible. ~~Other mechanisms for mitigating the effect of a disorderly shutdown are for further study.~~

NOTE – If errors on the other lines in the vectored group are acceptable, an additional and/or alternative technique to the switching-off of the transmit signal, is fast update of the coefficients. This may be effectuated as follows. When a DSE or other disorderly event is detected on a line, the VTU-Os of the other

lines should send error feedback requests preferably using robust eoc channel to their VTU-Rs. The VTU-Rs should then provide the requested error samples to the respective VTU-Os in the vectoring feedback channel. Upon receiving the error samples, it is sufficient that the VCE estimates only the changed channel coefficients, i.e., the channel coefficients associated with the line subject to DSE, in order to update an estimate of the full channel. This can be performed using error samples corresponding to a few sync symbols only. Then, the VCE uses the updated channel estimate comprising the estimated changed channel coefficients and the unchanged channel coefficients to update the pre-coder. The duration of the period of errors, before the pre-coder is updated using such a fast update mechanism, has an approximate length of a few superframes, and therefore may avoid the other lines to retrain due to the DSE.

7) Changes in clause 10.1, "Overview"

Replace "G.992.3" with "G.993.2" in Figure 10-1 (4 times) as follows:

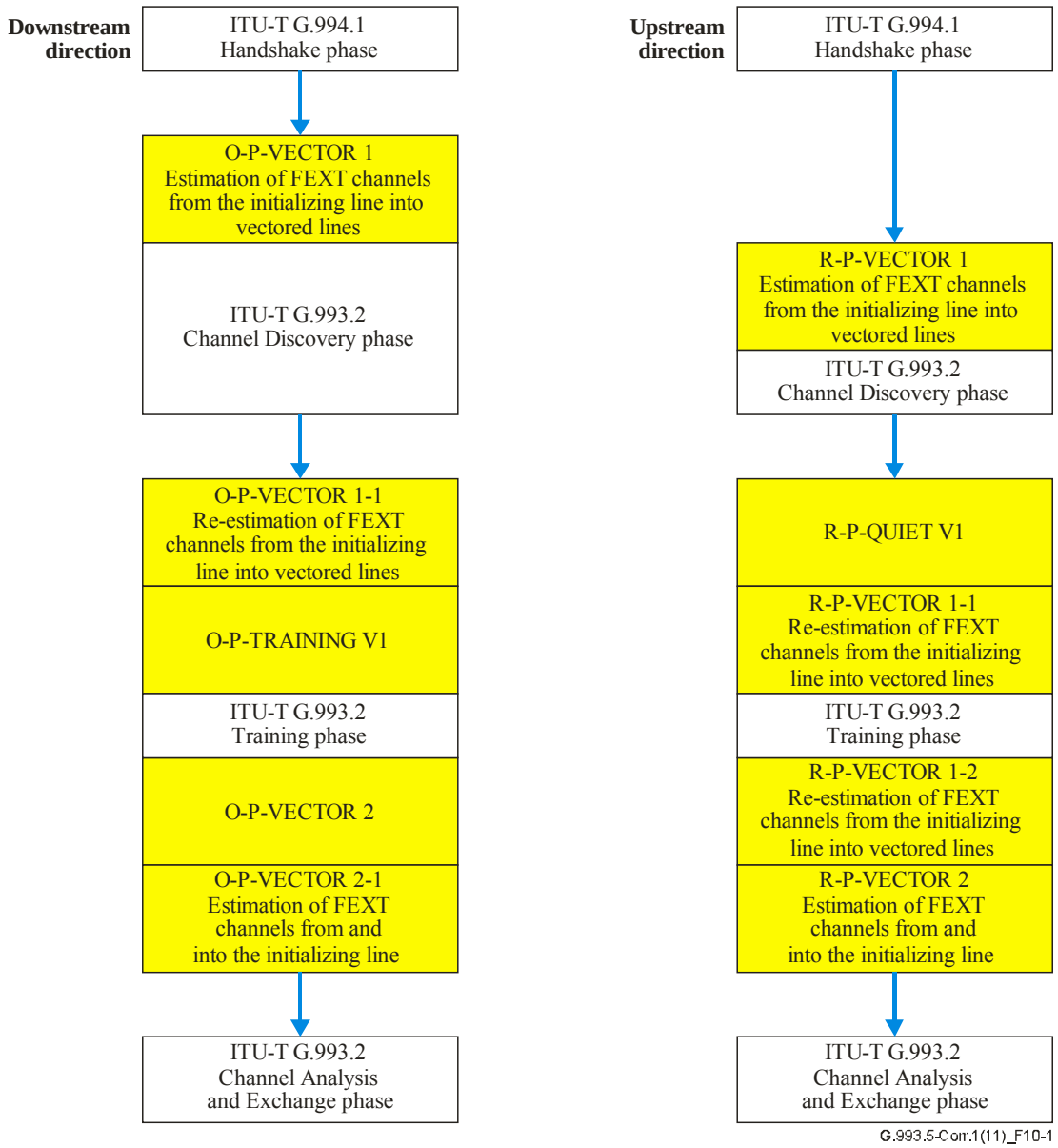

Figure 10-1 – ITU-T G.993.5 initialization overview

Change the text of the ninth paragraph as follows:

At the beginning of the Training phase, the initializing VTU-R will transmit the R-P-VECTOR 1-1 signal, which is the same as R-P-VECTOR 1 and allows the VCE to update the upstream FEXT channel estimates from the initializing lines into the vectored lines, prior to transitioning into the

ITU-T G.993.2 Training phase. The VTU-O transmits the ~~O-P-VECTOR 1-1~~ O-P-TRAINING V1 signal as a time fill signal while the VTU-R transmits R-P-VECTOR 1-1.

8) Changes in clause 10.3.2.1, "O-SIGNATURE"

Change the text as follows:

The O-SIGNATURE message which is transmitted during O-P-CHANNEL DISCOVERY V1 ~~and O-P-CHANNEL DISCOVERY 1~~ contains an ITU-T G.993.5 parameter field. The ITU-T G.993.5 parameter field contains several parameters needed for the FEXT cancellation operation, as shown in Table 10-1.

9) Changes in clause 10.4.3.4, "O-P-TRAINING 1 and O-P-TRAINING 2"

Change the text as follows:

These signals shall be identical to the O-P-TRAINING 1 and O-P-TRAINING 2 signals defined in clause 12.3.4.3.1 of [ITU-T G.993.2], respectively, with the addition of markers to indicate the downstream sync symbol positions and ~~down~~upstream pilot sequence positions (as defined in clause 10.3.3.5). The pattern of markers shall be continued taking into account all downstream sync symbol positions from the beginning of O-P-CHANNEL DISCOVERY V1.

NOTE – It is beneficial if O-P-SYNCHRO 4 and O-P-SYNCHRO 5 signals are not transmitted at downstream sync symbol positions.

10) Changes in clause 10.4.4.5, "R-P-VECTOR 2"

Add three rows to Table 10-6 as follows:

Table 10-6 – Bit mapping for R-P-VECTOR 2

Sub-carrier index	Constellation point
5, 10, 15,..., 5*n*, ...	00
1, 1/*R*+1, 2/*R*+1, ..., *n*/*R* + 1, ...	SOC message bits 0 and 1
2, 1/*R*+2, 2/*R*+2, ..., *n*/*R* + 2, ...	SOC message bits 2 and 3
...	...
10*k*+*m*, 1/*R*+10*k*+*m*, 2/*R*+10*k*+*m*, ..., *n*/*R*+10*k*+*m*, ... with $k = 0, 1, 2, \ldots, \frac{1}{10 \cdot R} - 1$ and *m* = 1, 2, 3, 4, 6, 7, 8, 9	SOC message bits 16*k*+*f*(*m*) and 16*k*+*f*(*m*)+1 with $f(m) = \begin{cases} 2m-2 & \text{if } m = 1,2,3,4 \\ 2m-4 & \text{if } m = 6,7,8,9 \end{cases}$
...	...
1/*R*–1, 2/*R*–1, 3/*R*–1, ..., *n* + 1/*R*–1, ...	SOC message bits $\frac{16}{10 \cdot R} - 2$ and $\frac{16}{10 \cdot R} - 1$

11) Changes in clause 11.2.1.2, "Reporting of downstream FEXT coupling coefficients (Xlogpsds)"

Change the last paragraph of this clause as follows:

Accuracy requirements for Xlogpsds shall allow for Xlogpsds to be the logarithm of the magnitude of the elements of the Taylor first-order approximation of the inverse of the pre-coder matrix (see Figure 6-1). Other accuracy requirements for Xlogpsds are for further study.

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