International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
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G.993.2

Amendment 6

(11/2010)

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 6: New Annex L and revision of channel initialization policy

Recommendation ITU-T G.993.2 (2006) – Amendment 6

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Recommendation ITU-T G.993.2

Very high speed digital subscriber line transceivers 2 (VDSL2)

Amendment 6

New Annex L and revision of channel initialization policy

Summary

Amendment 6 to Recommendation ITU-T G.993.2 (02/2006) includes the following:

1) ITU-T G.993.5-friendly ITU-T G.993.2 operation in the downstream direction.

2) Revision of CI policy = 1 and addition of new CI policy = 2.

History

Edition	Recommendation	Approval	Study Group
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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
1.3	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

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Very high speed digital subscriber line transceivers 2 (VDSL2)

Amendment 6

New Annex L and revision of channel initialization policy

1) New Annex L

Add new Annex L as follows:

Annex L

ITU-T G.993.5-friendly ITU-T G.993.2 operation in the downstream direction

(This annex forms an integral part of this Recommendation.)

This annex provides the necessary and sufficient additional requirements for ITU-T G.993.2 operation to allow cancellation of the downstream crosstalk from lines with ITU-T G.993.2 Annex L VTU-Rs into lines with ITU-T G.993.5 VTU-Rs (both connected to ITU-T G.993.5-capable VTU-Os).

This includes:

- Requirements for the ITU-T G.993.2 Annex L VTU-O downstream transmit signals.
- Requirements for the ITU-T G.993.2 Annex L VTU-R downstream receiver to be immune to the ITU-T G.993.2 Annex L VTU-O downstream transmit signals sent by the VTU-O during Initialization and Showtime. The VTU-R shall be immune to the VTU-O sending pilot sequences on the probe tones (as defined in ITU-T G.993.5) of the sync symbols during showtime.

A VTU-O operating according to this annex shall also support ITU-T G.993.5.

This annex is a delta to the main body of this Recommendation. The clause numbering scheme has been maintained.

NOTE – Simultaneous initialization of a line operating per ITU-T G.993.5-friendly ITU-T G.993.2 and a line operating per ITU-T G.993.5 is not supported in this annex. A possible solution is delaying the new initialization until the ongoing initialization is completed.

L.12.3 Initialization procedure (supplements clause 12.3)

If and only if the ITU-T G.994.1 VTU-O MS message or VTU-R MS message the NPar(2) bit "ITU-T G.993.5-friendly ITU-T G.993.2 operation in the downstream direction" is set to ONE, the VTU-O shall use a modified ITU-T G.993.2 initialization procedure, as defined in this annex.

This initialization procedure is identical to a ITU-T G.993.2 initialization procedure, except for the channel discovery phase and the training phase.

As applicable to the VTU-O, this initialization procedure defines two new signals to be transmitted.

As applicable to the VTU-R, this initialization procedure requires these two new signals to be ignored.

L.12.3.2 ITU-T G.994.1 Handshake phase

L.12.3.2.1 Handshake – VTU-O

L.12.3.2.1.1 CL messages (supplements clause 12.3.2.1.1)

Table 12-3 shall be extended with Table L.12-3 as follows :

Table L.12-3 – VTU-O CL message NPar(2) bit definitions

G.994.1 NPar(2) Bit	Definition of NPar(2) bit
ITU-T G.993.5-friendly ITU-T G.993.2 operation in the downstream direction	If set to ONE, indicates the capability of the VTU-O: • 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 • 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 • to send pilot sequences on the probe tones (as defined in ITU-T G.993.5) of the sync symbols during showtime.

L.12.3.2.1.2 MS messages (supplements clause 12.3.2.1.2)

Table 12-6 shall be extended with Table L.12-6 as follows :

Table L.12-6 – VTU-O MS message NPar(2) bit definitions

G.994.1 NPar(2) Bit	Definition of NPar(2) bit
ITU-T G.993.5-friendly ITU-T G.993.2 operation in the downstream direction	Set to ONE if and only if both the last previous CLR and the last previous CL messages have set this bit to ONE. If set to ONE, indicates that the VTU-O: • shall 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 • shall 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 • shall send pilot sequences on the probe tones (as defined in ITU-T G.993.5) of the sync symbols during showtime.

L.12.3.2.2 Handshake – VTU-R

L.12.3.2.2.1 CLR messages (supplements clause 12.3.2.2.1)

Table 12-9 shall be extended with Table L.12-9 as follows:

Table L.12-9 – VTU-R CLR message NPar(2) bit definitions

G.994.1 NPar(2) Bit	Definition of NPar(2) bit
ITU-T G.993.5-friendly ITU-T G.993.2 operation in the downstream direction	Set to ONE if the VTU-R is immune to a VTU-O: • sending O-P-VECTOR-1 (as defined in ITU-T G.993.5) after O-P-QUIET and before O-P-CHANNEL DISCOVERY 1; and • sending 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 • sending pilot sequences on the probe tones (as defined in ITU-T G.993.5) of the sync symbols during showtime.

L.12.3.2.2.2 MS messages (supplements clause 12.3.2.2.2)

Table 12-12 shall be extended with Table L.12-12 as follows :

Table L.12-12 – VTU-R MS message NPar(2) bit definitions

G.994.1 NPar(2) Bit	Definition of NPar(2) bit
ITU-T G.993.5 friendly ITU-T G.993.2 operation in the downstream direction	Shall be set to ONE if and only if both the last previous CLR and the last previous CL message have set this bit to ONE. If set to ONE, indicates that the VTU-O shall: • send O-P-VECTOR-1 (as defined in ITU-T G.993.5) after O-P-QUIET and before O-P-CHANNEL DISCOVERY 1; and • 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 • send pilot sequences on the probe tones (as defined in ITU-T G.993.5) of the sync symbols during showtime.

L.12.3.3 Channel discovery phase

L.12.3.3.1 Overview (supplements clause 12.3.3.1)

Figure L.12-4 replaces Figure 12-4.

The VTU-O shall initiate the start of the channel discovery phase with O-P-QUIET 1, as defined in this clause.

When in the ITU-T G.994.1 VTU-O MS message or VTU-R MS message the NPar(2) bit "ITU-T G.993.5-friendly ITU-T G.993.2 operation in the downstream direction" is set to ONE, the VTU-O shall use a modified ITU-T G.993.2 initialization procedure, by the insertion of ITU-T G.993.5 O-P-VECTOR 1 of duration no longer than 1024 × 257 symbols after O-P-QUIET 1.

NOTE – As applicable to the VTU-O, this channel discovery phase is identical to an ITU-T G.993.5 channel discovery phase with all segments x-P-VECTOR y-z set to zero length, except for O-P-VECTOR 1.

After completing the O-P-VECTOR 1 stage, the VTU-O shall start transmitting O-P-CHANNEL DISCOVERY 1 and proceed as defined in this clause.

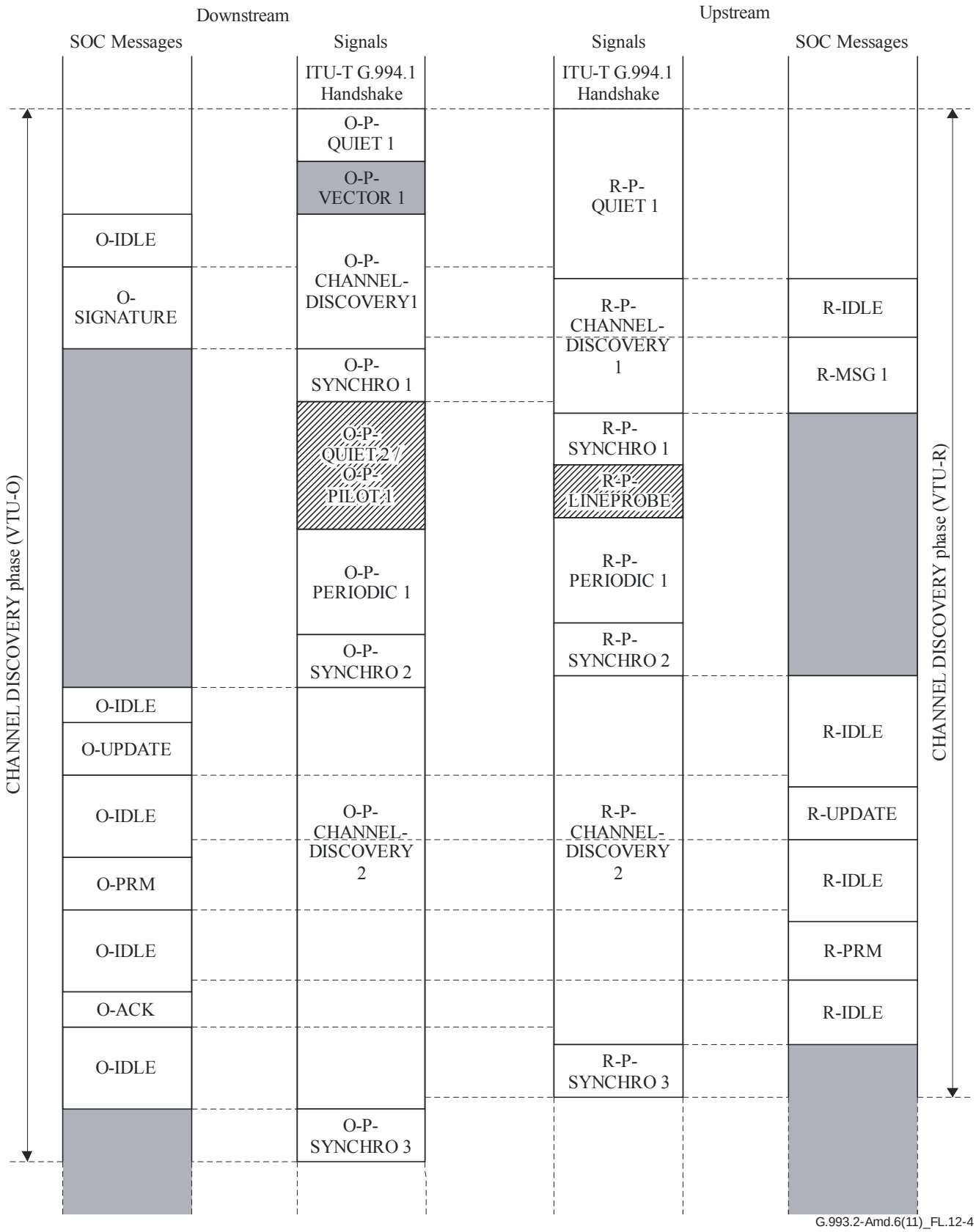

Figure L.12-4 – Timing diagram for the stages of the channel discovery phase

Table 12-15 shall be extended with Table L.12-15 as follows:

Table L.12-15 – VTU-O signals and SOC messages in the channel discovery phase

Signal	Signal type	Signal duration in DMT symbols with CE	SOC messages	SOC state
O-P-VECTOR 1	G.993.5	4 to 1024 × 257	None	Inactive

L.12.3.3.3 Signals transmitted during the channel discovery phase (supplements clause 12.3.3.3)

O-P-VECTOR 1 shall comply to the general requirements for signals transmitted during the channel discovery phase.

L.12.3.3.3.1 Signals transmitted by the VTU-O

L.12.3.3.3.1.1a O-P-VECTOR 1 (supplements clause 12.3.3.3.1 between clauses 12.3.3.3.1.1 and 12.3.3.3.1.2)

O-P-VECTOR 1 shall be as defined in ITU-T G.993.5.

L.12.3.3.3.1.9 O-P-SYNCHRO 3 (replaces clause 12.3.3.3.1.9)

O-P-SYNCHRO 3 is a signal that provides an exact time marker for transitions from O-P-CHANNEL DISCOVERY 2 to O-P-VECTOR 1-1 (training phase).

O-P-SYNCHRO 3 shall be identical to O-P-SYNCHRO 1.

L.12.3.4 Training phase

L.12.3.4.1 Overview (supplements clause 12.3.4.1)

Figure L.12-6 replaces Figure 12-6.

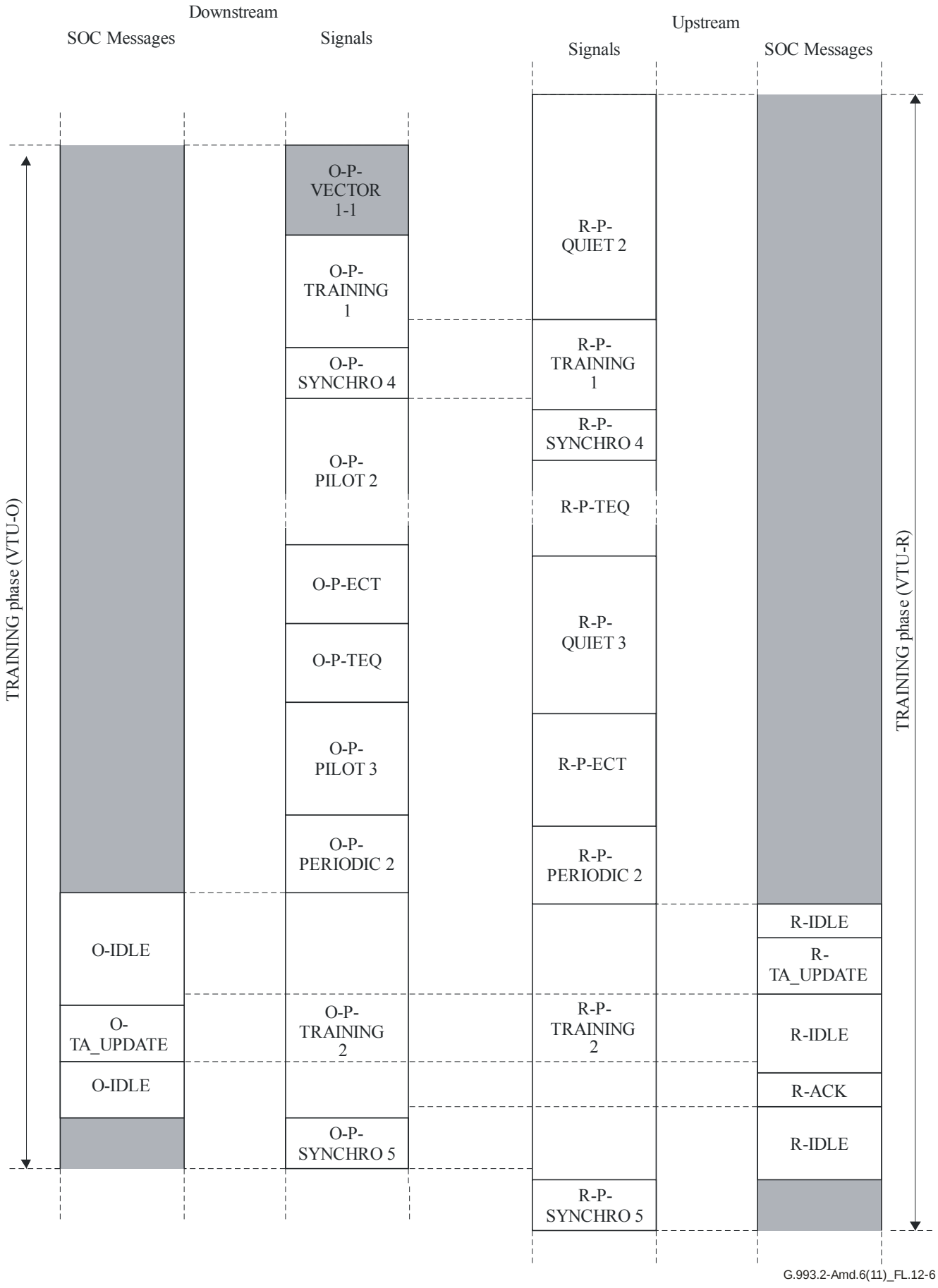

Figure L.12-6 – Timing diagram for the stages of the training phase

When in the ITU-T G.994.1 VTU-O MS message or VTU-R MS message the NPar(2) bit "ITU-T G.993.5-friendly ITU-T G.993.2 operation in the downstream direction" is set to ONE, at the start of the training phase, the VTU-O shall transmit O-P-VECTOR 1-1, and the VTU-R shall be silent (R-P-QUIET 2). O-P-VECTOR 1-1 shall be followed by O-P-TRAINING 1, while the VTU-R is still silent (R-P-QUIET 2). The remainder of the initialization procedure shall be as defined in this clause.

NOTE – As applicable to the VTU-O, this training phase is identical to an ITU-T G.993.5 training phase with all segments x-P-VECTOR y-z set to zero length except for O-P-VECTOR 1-1.

Table 12-30 shall be extended with Table L.12-30 as follows:

Table L.12-30 – VTU-O signals and SOC messages in the training phase

Signal	Signal type	Signal duration in DMT symbols with CE	SOC messages	SOC state
O-P-VECTOR 1-1	G.993.5	4 to 1024 × 257	None	Inactive

L.12.3.4.3 Signals transmitted during the training phase (supplements clause 12.3.4.3)

O-P-VECTOR 1-1 shall comply to the general requirements for signals transmitted in the training phase.

L.12.3.4.3.1 Signals transmitted by the VTU-O

L.12.3.4.3.1.0 O-P-VECTOR 1-1 (supplements clause 12.3.4.3.1 preceding clause 12.3.4.3.1.1)

O-P-VECTOR 1-1 shall be as defined in ITU-T G.993.5.

2) Clause 12.3.7 and clauses of Annex K

Revise clause 12.3.7 "Channel initialization policies" and clauses of Annex K as follows:

12.3.7 Channel initialization policies

The method used by the receiver to select the values of transceiver parameters described in this clause is implementation dependent. However, within the limit of the total data rate provided by the local PMD, the selected values shall meet all of the constraints communicated by the transmitter prior to the channel analysis & exchange phase, including:

- Message overhead data rate ≥ Minimum message overhead data rate;
- Net data rate ≥ Minimum net data rate for all bearer channels;
- Impulse noise protection ≥ Minimum impulse noise protection for all bearer channels;
- Delay ≤ Maximum delay for all bearer channels;
- SNR Margin ≥ TARSNRM.

Within those constraints, the receiver shall select the values as to optimize in the priority given in one of the priority lists below, where the selection of the list is configured through the CO-MIB channel initialization policy parameter (CIPOLICY, see 7.3.2.10/G.997.1). The channel initialization policy applies only for the selection of the values exchanged during initialization, and does not apply during showtime.

The following channel initialization policies are defined:

- Policy ZERO if $CIpolicy_n$=0, then:

1) Maximize net data rate for all bearer channels, per the allocation of the net data rate, in excess of the sum of the minimum net data rates over all bearer channels (see clause 12.3.5).

2) Minimize excess margin with respect to the maximum SNR margin (MAXSNRM) through gain adjustments (see clause 10.3.4.2). Other control parameters may be used to achieve this (e.g., MAXMASK, see clause 7.2.3).

- Policy ONE if $CIpolicy_n$=1, then:

a) If the minimum net data rate (see clause 7.3.2.1.1/G.997.1) is set equal to the maximum net data rate (see clause 7.3.2.1.3/G.997.1), then

1) Maximize INP_act_n for the bearer channel #*n*.

b) If the minimum net data rate (see clause 7.3.2.1.1/G.997.1) is not set equal to the maximum net data rate (see clause 7.3.2.1.3/G.997.1), then

1) Maximize net data rate for all the bearer channels, per the allocation of the net data rate, in excess of the sum of the minimum net data rates over all bearer channels (see clause 12.3.5).

2) If such maximized net data rate is equal to the maximum net data rate (see clause 7.3.2.1.3/G.997.1), maximize INP_act_n for the bearer channel #*n*.

3) Minimize excess margin with respect to the maximum noise margin MAXSNRM through gain scalings (see clause 10.3.4.2). Other control parameters may be used to achieve this (e.g., MAXMASK, see clause 7.2.3).

- Policy TWO if $CIpolicy_n$= 2, then:

1) Maximize net data rate for all the bearer channels, per the allocation of the net data rate, in excess of the sum of the minimum net data rates over all bearer channels (see clause 12.3.5).

2) If such maximized net data rate is equal to the maximum net data rate (see clause 7.3.2.1.3/G.997.1), maximize $SNRM_n$ for the bearer channel #*n*.

3) Minimize excess margin with respect to the maximum noise margin MAXSNRM through gain scalings (see clause 10.3.4.2). Other control parameters may be used to achieve this (e.g., MAXMASK, see clause 7.2.3).

~~If the CO-MIB sets the CIPOLICY to ONE for a bearer channel, it shall have the minimum net data rate set equal to the maximum net data rate and shall have the MAXSNRM set to infinity.~~

If only a single bearer channel is configured through the CO-MIB, then the CIPOLICY shall be set to ZERO, ~~or~~ ONE or TWO. If multiple bearer channels are configured through the CO-MIB, then the CIPOLICY shall be set to ZERO for each of the bearer channels. The use of the channel initialization policy ONE or TWO with multiple bearer channels is for further study.

Support of channel initialization policy ZERO is mandatory. Support of channel initialization policy ONE or TWO is optional. Additional channel initialization policies are for further study. The $CIpolicy_n$ parameter values other than 0, ~~and~~ 1 and 2 are reserved for use by the ITU-T.

K.1.7.1 Valid configurations

The configurations listed in Table K.3 are valid for the STM-TC function.

Table K.3 – Valid configuration for STM-TC function

Parameter	Capability
$type_n$	1
net_min_n	net_min_n may be supported for all valid framing configurations.
net_max_n	net_max_n may be supported for all valid framing configurations.
$net\_reserve_n$	$net\_reserve_n$ may be supported for all valid framing configurations.
$MIN\text{-}SOS\text{-}BR_n$	$MIN\text{-}SOS\text{-}BR_n$ may be supported for all valid framing configurations.
$delay\_max_n$	All valid values of $delay\_max_n$ (see Table 12-44).
INP_min_n	All valid values of INP_min_n (Table 12-44).
$CIpolicy_n$	0, 1, 2

K.2.7.1 Valid configurations

The configurations listed in Table K.9 are valid for the ATM-TC function.

Table K.9 – Valid configuration for ATM-TC function

Parameter	Capability
$type_n$	2
net_min_n	net_min_n may be supported for all valid framing configurations.
net_max_n	net_max_n may be supported for all valid framing configurations.
$net\_reserve_n$	$net\_reserve_n$ may be supported for all valid framing configurations.
$MIN\text{-}SOS\text{-}BR_n$	$MIN\text{-}SOS\text{-}BR_n$ may be supported for all valid framing configurations.
$delay\_max_n$	All valid values of $delay\_max_n$ (see Table 12-44).
INP_min_n	All valid values of INP_min_n (Table 12-44).
$CIpolicy_n$	0, 1, 2

K.3.7.1 Valid configuration

The configurations listed in Table K.16 are valid for the PTM-TC function.

Table K.16 – Valid configuration for PTM-TC function

Parameter	Capability
$type_n$	3
net_min_n	net_min_n may be supported for all valid framing configurations.
net_max_n	net_max_n may be supported for all valid framing configurations.
$net\_reserve_n$	$net\_reserve_n$ may be supported for all valid framing configurations.
$MIN\text{-}SOS\text{-}BR_n$	$MIN\text{-}SOS\text{-}BR_n$ may be supported for all valid framing configurations.
$delay\_max_n$	All valid values of $delay\_max_n$ (see Table 12-44).
INP_min_n	All valid values of INP_min_n (Table 12-44).
$CIpolicy_n$	0, 1, 2

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