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Amendment 4

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

Digital sections and digital line system – Access networks

Physical layer management for digital subscriber line (DSL) transceivers

Amendment 4

Recommendation ITU-T G.997.1 (2009) – Amendment 4

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For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T G.997.1

Physical layer management for digital subscriber line (DSL) transceivers

Amendment 4

Summary

Amendment 4 to Recommendation ITU-T G.997.1 (2009) contains the following additions:

– Change to the reporting of downstream crosstalk channel XLINds.
– Addition of the reporting of the upstream crosstalk channel XLINus.
– Management of SRA and SOS with retransmission.
– Addition of line parameter for maximum delay octet split between downstream and upstream direction.
– Addition of new HPE bandplans.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T G.997.1	1999-07-02	15
2.0	ITU-T G.997.1	2003-05-22	15
2.1	ITU-T G.997.1 (2003) Amd. 1	2003-12-14	15
2.2	ITU-T G.997.1 (2003) Amd. 2	2005-01-13	15
3.0	ITU-T G.997.1	2005-09-06	15
4.0	ITU-T G.997.1	2006-06-06	15
4.1	ITU-T G.997.1 (2006) Cor. 1	2006-12-14	15
4.2	ITU-T G.997.1 (2006) Amd. 1	2006-12-14	15
4.3	ITU-T G.997.1 (2006) Amd. 2	2007-11-22	15
4.4	ITU-T G.997.1 (2006) Amd. 3	2008-08-22	15
5.0	ITU-T G.997.1	2009-04-22	15
5.1	ITU-T G.997.1 (2009) Cor. 1	2009-11-13	15
5.2	ITU-T G.997.1 (2009) Amd. 1	2010-06-11	15
5.3	ITU-T G.997.1 (2009) Amd. 2	2010-11-29	15
5.4	ITU-T G.997.1 (2009) Amd. 3	2011-06-22	15
5.5	ITU-T G.997.1 (2009) Cor. 2	2011-10-29	15
5.6	ITU-T G.997.1 (2009) Amd. 4	2011-12-16	15

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Recommendation ITU-T G.997.1

Physical layer management for digital subscriber line (DSL) transceivers

Amendment 4

1) Modification of the reporting of downstream XLIN and addition of the reporting of upstream XLIN

1.1) Clauses 7.3.1.13.7 and 7.3.1.13.8

Add clauses 7.3.1.13.7 and 7.3.1.13.8:

7.3.1.13.7 Downstream requested XLIN subcarrier group size (XLINGREQds)

This parameter is the requested value of XLINGds. The valid values are 1, 2, 4, 8, 16, 32 and 64.

7.3.1.13.8 Upstream requested XLIN subcarrier group size (XLINGREQus)

This parameter is the requested value of XLINGus.

1.2) Clause 7.5.1.39

Replace clause 7.5.1.39 by the following:

7.5.1.39 Test parameters for Recommendation ITU-T G.993.5

7.5.1.39.1 Downstream XLIN scale (XLINSCds)

This parameter is the scale factor to be applied to the downstream Xlinpsds values. It is represented as an unsigned integer in the range from 1 to $2^{16} – 1$.

7.5.1.39.2 Downstream XLIN subcarrier group size (XLINGds)

This parameter is the number of subcarriers per group used to report Xlinpsds. The valid values are 1, 2, 4, 8, 16, 32, and 64. XLINGds should equal the sub-sampling factor used to estimate the crosstalk channel for cancellation. This value may be different from *F_sub* (see ITU-T G.993.5 for the definition of *F_sub*).

7.5.1.39.3 Downstream XLIN bandedges (XLINBANDSds)

XLINBANDSds contains pairs of (start_subcarrier_index, stop_subcarrier_index) for every band in which XLINpsds is reported.

7.5.1.39.4 Downstream FEXT coupling (XLINpsds)

For each given VCE port index k, this parameter is a one-dimensional array of complex values in linear scale for downstream FEXT coupling coefficients Xlinds(f) originating from the loop connected to the VCE port k into the loop for which Xlinds(f) is being reported. Each array entry represents the Xlinds($f = n \times \Delta f$) value for a particular subcarrier index n. The Xlinds($f = n \times \Delta f$) value is represented as $((XLINSCds/2^{15}) * ((a(n) + j \times b(n))/2^{15}))$, where a(n) and b(n) are signed integers in the $(–2^{15} + 1)$ to $(+2^{15} – 1)$ range. A special value indicates that no measurement could be done from line k into this line for subcarrier n. Another special value indicates that there is no phase information and the magnitude of Xlinds($f = n \times \Delta f$) is $((XLINSCds/2^{15}) \times (a(n)/2^{15}))$.

The format of XLINpsds is defined in [ITU-T G.993.5].

7.5.1.39.5 Upstream XLIN scale (XLINSCus)

This parameter is the scale factor to be applied to the Upstream Xlinpsus values. It is represented as an unsigned integer in the range from 1 to $2^{16} – 1$.

7.5.1.39.6 Upstream XLIN subcarrier group size (XLINGus)

This parameter is the number of subcarriers per group used to report Xlinpsus. The valid values are 1, 2, 4, 8, 16, 32, and 64.

7.5.1.39.7 Upstream XLIN bandedges (XLINBANDSus)

XLINBANDSus contains pairs of (start_subcarrier_index, stop_subcarrier_index) for every band in which XLINpsus is reported.

7.5.1.39.8 Upstream FEXT coupling (XLINpsus)

For each given VCE port index k, this parameter is a one-dimensional array of complex values in linear scale for upstream FEXT coupling coefficients Xlinus(f) originating from the loop connected to the VCE port k into the loop for which Xlinus(f) is being reported. Each array entry represents the Xlinus(f = n × Δf) value for a particular subcarrier index n. The Xlinus(f = n × Δf) value is represented as $((XLINSCus/2^{15}) \times ((a(n) + j \times b(n))/2^{15}))$, where a(n) and b(n) are signed integers in the $(–2^{15} + 1)$ to $(+2^{15} – 1)$ range. A special value indicates that no measurement could be done from line k into this line for subcarrier n. Another special value indicates that there is no phase information and the magnitude of Xlinus(f = n × Δf) is $((XLINSCus/2^{15}) \times (a(n)/2^{15}))$.

The format of XLINpsus is defined in [ITU-T G.993.5].

1.3) Table 7-14

Add the following rows to Table 7-14:

Table 7-14 – Line configuration profile

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
...					
FEXT cancellation enabling/disabling downstream (FEXT_CANCEL_ENABLEds)	7.3.1.13.6	R/W (M)			
XLINGREQds	7.3.1.13.7	R/W(M)			
XLINGREQus	7.3.1.13.8	R/W(M)			

1.4) Table 7-15

Add the following rows to Table 7-15:

Table 7-15 – Support of line configuration parameters per Recommendation

Category/ Element	ITU-T G.992.1	ITU-T G.992.2	ITU-T G.992.3	ITU-T G.992.4	ITU-T G.992.5	ITU-T G.993.2	ITU-T G.993.5
...							
FEXT_CANCEL_ ENABLEds							Y
XLINGREQds							Y
XLINGREQus							Y

1.5) Table 7-28

Modify Table 7-28 as follows:

Table 7-28 – Line test, diagnostic and status parameters

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface	G-Interface
...						
ITU-T G.993.5 specific (Vectoring)						
~~FEXT coupling function downstream (XLOGds)~~	~~7.5.1.39.1~~	~~R (M)~~				
~~Downstream XLOG subcarrier group size (XLOGGds)~~	~~7.5.1.39.2~~	~~R (M)~~				
XLINSCds	7.5.1.39.1	R (M)				
XLINGds	7.5.1.39.2	R (M)				
~~XLINGREQds~~	~~7.5.1.39.2~~	~~R/W (M)~~				
XLINBANDSds	7.5.1.39.3 ~~2~~	R (M)				
XLINpsds	7.5.1.39.4 ~~3~~	R (M)				
XLINSCus	7.5.1.39.5 ~~4~~	R (M)				
XLINGus	7.5.1.39.6 ~~5~~	R (M)				
~~XLINGREQus~~	~~7.5.1.39.2~~	~~R/W (M)~~				
XLINBANDSus	7.5.1.39.7 ~~2~~	R (M)				
XLINpsus	7.5.1.39.8 ~~6~~	R (M)				

1.6) Table 7-29

Modify Table 7-29 as follows:

Table 7-29 – Support of line test, diagnostic and status parameters per Recommendation

Category/Element	ITU-T G.992.1	ITU-T G.992.2	ITU-T G.992.3	ITU-T G.992.4	ITU-T G.992.5	ITU-T G.993.2	ITU-T G.993.5
...							
ITU-T G.993.5 specific (Vectoring)							
~~XLOGds~~							~~Y~~
~~XLOGGds~~							~~Y~~
XLINSCds							Y
XLINGds							Y
~~XLINGREQds~~							~~Y~~
XLINBANDSds							Y
XLINpsds							Y
XLINSCus							Y
XLINGus							Y
~~XLINGREQus~~							~~Y~~
XLINBANDSus							Y
XLINpsus							Y

2) Management of SRA and SOS with retransmission

2.1) Clause 7.3.1.4.1

Modify clause 7.3.1.4.1 as follows:

7.3.1.4.1 Downstream rate adaptation mode (RA-MODEds)

This parameter specifies the mode of operation of a rate-adaptive xTU-C in the transmit direction. The parameter can take four values: Mode 1, 2, 3 or 4.

NOTE 1 – Modes 1 and 2 are both mandatory modes. The commonality between Modes 1 and 2 is that both are characterized by a constant data rate in showtime. The difference between Modes 1 and 2 is that Mode 1 fixes this data rate at the configured minimum data rate, whereas Mode 2 forces the modem subsystem to fix the data rate within the range determined by the configured minimum and maximum data rates. In case of ITU-T G.998.4 operation, the 'data rate' is replaced in the above by 'expected throughput'.

~~Modes 3 and 4 are optional modes that mandate rate changes under specific conditions. In [ITU-T G.998.4], retransmission operation is not possible simultaneously with Modes 3 or 4. This implies a fall-back to Mode 2 when the xTU decides to operate in ITU-T G.998.4 mode and Mode 3 or 4 is configured.~~

Mode 1: MANUAL – Data rate/Expected throughput changed manually.

Support of this mode is mandatory.

In case ITU-T G.998.4 retransmission is not used in the downstream direction

The downstream minimum data rate parameter (see clause 7.3.2.1.1) specifies the exact data rate the xTU-C transmitter shall operate at for each of the bearer channels.

NOTE 2 – The downstream minimum data rate parameter value shall override the configured maximum data rate parameter value (see clause 7.3.2.1.3).

Although the xTU-C and the line might be able to support a higher data rate, the xTU-C shall not transmit a higher data rate than what is requested for each of the bearer channels.

At startup

a) For [ITU-T G.992.1] and [ITU-T G.992.2], the channel initialization policy is defined in this paragraph. The ATUs shall initialize with a downstream noise margin which is at least as large as the specified downstream target noise margin, TARSNRMds (see clause 7.3.1.3.1), relative to the required BER for each of the downstream bearer channels, or better.

   If the xTU-C fails to achieve the downstream minimum data rate for one of the bearer channels, the xTU-C will fail to initialize, and the NMS will be notified.

b) For operational modes other than [ITU-T G.992.1] or [ITU-T G.992.2], the channel initialization policy is defined in the relevant Recommendation and controlled by the CIPOLICY parameter (see clause 7.3.2.10).

At showtime

The xTU-C transmitter shall maintain the specified downstream minimum data rate for each of the bearer channels.

In case ITU-T G.998.4 retransmission is used in the downstream direction

The downstream MINETR_RTX parameter (see clause 7.3.2.1.8) specifies the exact expected throughput the xTU-C transmitter shall operate at.

NOTE 3 – The downstream MINETR_RTX parameter value shall override the configured downstream MAXETR_RTX parameter value (see clause 7.3.2.1.9).

At startup

The channel initialization policy is defined in [ITU-T G.998.4] (see clause 11.5 of [ITU-T G.998.4]).

At showtime

The xTU-C transmitter shall maintain the specified downstream minimum expected throughput.

Mode 2: AT_INIT – Data rate/Expected throughput automatically selected at startup only and does not change after that.

Support of this mode is mandatory.

In case ITU-T G.998.4 retransmission is not used in the downstream direction

The downstream minimum data rate parameter (see clause 7.3.2.1.1) and downstream maximum data rate parameter (see clause 7.3.2.1.3) specify the data rate range within which the xTU-C transmitter shall operate for each of the bearer channels. The data rate is determined during initialization and remains constant during the subsequent showtime phase.

At startup

a) For [ITU-T G.992.1] and [ITU-T G.992.2], the channel initialization policy is defined in this paragraph. The ATUs shall initialize at a downstream data rate in the range between minimum data rate and maximum data rate and with a downstream noise margin which is at least as large as the specified downstream target noise margin, TARSNRMds (see clause 7.3.1.3.1), relative to the required BER for each of the bearer channels, or better.

   If the xTU-C fails to achieve the downstream minimum data rate for one of the bearer channels, the xTU-C will fail to initialize, and the NMS will be notified.

   If the xTU-C transmitter is able to support a higher downstream data rate at initialization, the excess data rate will be distributed amongst the downstream bearer channels according to the ratio (0 to 100%) specified by the rate adaptation ratio parameter for each bearer channel (adding up to 100% over all bearer channels). When the downstream maximum data rate is achieved in one of the bearer channels, then the remaining excess bit rate is assigned to the other bearer channels, still according to their relative rate adaptation ratio parameters.

   As long as the downstream data rate is below the downstream maximum data rate for one of the bearer channels, data rate increase shall take priority over transmit power reduction.

b) For operational modes other than [ITU-T G.992.1] or [ITU-T G.992.2], the channel initialization policy is defined in the relevant Recommendation and controlled by the CIPOLICY parameter (see clause 7.3.2.10).

At showtime

During showtime, no downstream data rate adaptation is allowed. The downstream data rate, which has been selected during initialization for each of the bearer channels, shall be maintained.

In case ITU-T G.998.4 retransmission is used in the downstream direction

The downstream MINETR_RTX parameter (see clause 7.3.2.1.8) and downstream MAXETR_RTX parameter (see clause 7.3.2.1.9) specify the range of the expected throughput within which the xTU-C transmitter shall operate at.

The expected throughput (ETR) is determined during initialization and remains constant during the subsequent showtime phase.

At startup

The channel initialization policy is defined in [ITU-T G.998.4] (see clause 11.5 of [ITU-T G.998.4]).

At showtime

During showtime, no downstream data rate adaptation is allowed. The downstream expected throughput, which has been selected during initialization, shall be maintained.

Mode 3: DYNAMIC – Data rate/Expected throughput is automatically selected at initialization and is continuously adapted during operation (showtime). The DYNAMIC rate adaptation mode is optional. All related configuration parameters are also optional.

In case ITU-T G.998.4 retransmission is not used in the downstream direction

At startup

In Mode 3, the xTU-C shall start up as in Mode 2.

At showtime

• Rate range

During showtime, rate adaptation is allowed with respect to the rate adaptation ratio for distributing the excess data rate amongst the bearer channels (see Mode 2), and assuring that the downstream minimum data rate remains available at the required BER for each of the bearer channels or better. The downstream data rate can vary between the downstream minimum data rate, and the downstream maximum data rate.

• Procedure

SRA may be performed, when the conditions specified by the SRA trigger parameters are satisfied.

If operating in [ITU-T G.992.3] or [ITU-T G.992.5], the detailed specification of SRA OLR procedure is in [ITU-T G.992.3] with trigger conditions specified below.

-Downstream rate adaptation is performed when the conditions specified for downstream upshift noise margin and downstream upshift interval – or for downstream downshift noise margin and downstream downshift interval – are satisfied. This means:

– For an upshift action: Allowed when the downstream noise margin is above the downstream upshift noise margin during downstream minimum time interval for upshift rate adaptation (i.e., upon RAU anomaly – see [ITU-T G.992.3]).

– For a downshift action: Allowed when the downstream noise margin is below the downstream downshift noise margin during downstream minimum time interval for downshift rate adaptation (i.e., upon RAD anomaly – see [ITU-T G.992.3]).

As long as the downstream data rate is below the downstream maximum data rate for one of the bearer channels, data rate increase shall take priority over transmit power reduction.

If operating in [ITU-T G.993.2], the detailed specification of SRA OLR procedure and the trigger conditions are in [ITU-T G.993.2]. As long as the downstream data rate is below the downstream maximum data rate for one of the bearer channels, data rate increase shall take priority over transmit power reduction.

• Fallback

If in [ITU-T G.993.2], it is detected at startup that SRA is not supported in the downstream direction by either XTUs, the XTUs shall fallback to Mode 2. This shall be reported by the dowstream actual rate adaptation mode parameter, ACT-RA-MODEds (see clause 7.5.1.33.1).

In case ITU-T G.998.4 retransmission is used in the downstream direction

At startup

In Mode 3, the xTU-C shall start up as in Mode 2.

At showtime

~~No rate changes are allowed in [ITU-T G.998.4]. Because of this, the downstream RA-MODE shall fall back to RA-MODE = 2. This shall be reported by the dowstream actual rate adaptation mode parameter, ACT-RA-MODEds (see clause 7.5.1.33.1).~~

SRA OLR procedures are defined in [ITU-T G.998.4].

• Rate range

The downstream MINETR_RTX parameter (see clause 7.3.2.1.8) and downstream MAXETR_RTX parameter (see clause 7.3.2.1.9) specify the range of the expected throughput (ETR) within which the xTU-C transmitter shall operate at. The ETR is determined during initialization and updated in showtime upon OLR.

If ETR reaches its maximum value MAXETR_RTX, the NDR may be further increased without increasing the ETR. The downstream MAXNDR_RTX parameter (see clause 7.3.2.1.10) specifies maximum allowed value for the net data rate NDR within which the xTU-C transmitter shall operate at. The NDR is determined during initialization and updated in showtime upon OLR.

• Procedure

SRA may be performed, when the conditions specified by the SRA trigger parameters are satisfied.

If operating in [ITU-T G.992.3] or [ITU-T G.992.5], the detailed specification of SRA OLR procedure is in [ITU-T G.998.4] with the same trigger conditions as those specified in the case in which ITU T G.998.4 retransmission is not used (see above).

If operating in [ITU-T G.993.2], the detailed specification of SRA OLR procedure is in [ITU-T G.998.4] with trigger conditions specified in clause C.3.3 of [ITU-T G.998.4]. As long as the downstream NDR is below the downstream MAXNDR_RTX, data rate increase shall take priority over transmit power reduction.

• Fallback

If operating in [ITU-T G.993.2] and it is detected at startup that SRA is not supported in the downstream direction by either XTUs, the XTUs shall fallback to RA-Mode = 2. This shall be reported by the dowstream actual rate adaptation mode parameter, ACT-RA-MODEds (see clause 7.5.1.33.1).

NOTE 4 – If operating in [ITU-T G.992.3], SRA support is not exchanged at startup. Therefore, it is not possible to determine the actual RA-MODE at the start of showtime. Therefore, the parameter ACT-RA-MODE is not defined in [ITU-T G.992.3].

Mode 4: DYNAMIC with SOS – Data rate/Expected throughput is automatically selected at initialization and may be continuously adapted during operation (showtime) by SOS and SRA. The rate adaptation Mode 4 is optional. In this mode, enabling of SOS and SRA is mandatory.

In case ITU-T G.998.4 retransmission is not used in the downstream direction

At startup

In Mode 4, the xTU-C shall start up as in Mode 2.

At showtime

• Procedure

SRA behaviour shall be identical as described for Mode 3, unless the actual data rate is below the minimum data rate as a result of an SOS procedure.

Additionally, SOS may be performed, when the conditions specified by the SOS trigger parameters are satisfied. The detailed specification of SOS OLR procedure is in [ITU-T G.993.2].

• Fallback

If at startup, it is detected that SOS is not supported in the downstream direction by either XTUs, but SRA is supported by both XTUs, the XTUs shall fallback to Mode 3. This shall be reported by the dowstream actual rate adaptation mode parameter, ACT-RA-MODEds (see clause 7.5.1.33.1).

If at startup, it is detected that SOS is not supported in the downstream direction by either XTUs, and SRA is not supported by either XTUs, the XTUs shall fallback to Mode 2. This shall be reported by the dowstream actual rate adaptation mode parameter, ACT-RA-MODEds (see clause 7.5.1.33.1).

In case ITU-T G.998.4 retransmission is used in the downstream direction

At startup

In Mode 4, the xTU-C shall start up as in Mode 2.

At showtime

~~No rate changes are allowed in [ITU-T G.998.4]. Because of this, the downstream RA-MODE shall fall back to RA-MODE = 2. This shall be reported by the dowstream actual rate adaptation mode parameter, ACT-RA-MODEds (see clause 7.5.1.33.1).~~

SRA and SOS OLR procedures are defined in [ITU-T G.998.4].

• Procedure

If it is detected at startup that SOS and SRA is supported in the downstream direction by both XTUs:

– SRA may be performed as described for Mode 3.
– Additionally, SOS may be performed. The detailed specification of SOS OLR procedure is in [ITU-T G.998.4] with trigger conditions and rate constraints specified in clause C.3.3 of [ITU-T G.998.4].
– Additionally, SRA may be performed as a result of an SOS procedure. The detailed specification of SRA OLR procedure is in [ITU-T G.998.4] with trigger conditions and rate constraints specified in clause C.3.3 of [ITU-T G.998.4].

• Fallback

If it is detected at startup that SOS is not supported in the downstream direction by either XTUs, but SRA is supported by both XTUs, the XTUs shall fallback to Mode 3. This shall be reported by the dowstream actual rate adaptation mode parameter, ACT-RA-MODEds (see clause 7.5.1.33.1).

If it is detected at startup that SOS is not supported in the downstream direction by either XTUs, and that SRA is not supported in the downstream direction by either XTUs, the XTUs shall fallback to Mode 2. This shall be reported by the dowstream actual rate adaptation mode parameter, ACT-RA-MODEds (see clause 7.5.1.33.1).

3) Addition of line parameter to control the memory split parameters (MDOSPLIT)

3.1) Clause 7.3.1.14

Add clause 7.3.1.14:

7.3.1.14 MAXDELAYOCTET-split parameter (MDOSPLIT)

The line configuration parameter MAXDELAYOCTET-split (MDOSPLIT) defines the percentage of the MAXDELAYOCTET allocated to the downstream direction. All of the remaining MAXDELAYOCTET shall be allocated for use in the upstream direction.

The detailed specification is in [ITU-T G.993.2] and [ITU-T G.998.4].

MDOSPLIT shall be expressed as a percentage, with valid range from 5 percent to 95 percent inclusive, in steps of 1 percent. The value 0% is valid only if the maximum downstream interleaving delay is configured with the special value S1 (see clause 7.3.2.2) and retransmission is disabled in the downstream direction. The value 100% is valid only if the maximum upstream interleaving delay is configured with the special value S1 (see clause 7.3.2.2) and retransmission is disabled in the upstream direction. A special value shall indicate that the VTU-O is allowed to use a vendor discretionary algorithm.

NOTE – The special value is introduced to ensure backwards compatibility.

3.2) Table 7-14

Add the following row to Table 7-14:

Table 7-14 – Line configuration profile

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
...					
FEXT cancellation enabling/disabling downstream (FEXT_CANCEL_ENABLEds)	7.3.1.13.6	R/W (M)			
MAXDELAYOCTET split					
MDOSPLIT	7.3.1.14	R/W(O)			

3.3) Table 7-15

Add the following row to Table 7-15:

Table 7-15 – Support of line configuration parameters per Recommendation

Category/ Element	ITU-T G.992.1	ITU-T G.992.2	ITU-T G.992.3	ITU-T G.992.4	ITU-T G.992.5	ITU-T G.993.2	ITU-T G.993.5
...							
FEXT_CANCEL_ ENABLEds							Y
MAXDELAYOCTET split							
MDOSPLIT						Y	

4) Addition of new HPE bandplan

4.1) Clause 7.3.1.2.15

Modify clause 7.3.1.2.15 as follows:

7.3.1.2.15 VDSL2 PSD mask class selection (CLASSMASK)

In order to reduce the number of configuration possibilities, the limit power spectral density masks (limit PSD masks) are grouped in the following PSD mask classes:

– Class 998 Annex A/G.993.2: D-32, D-48, D-64, D-128.

– Class 997-M1c Annex B/G.993.2: 997-M1c-A-7.

– Class 997-M1x Annex B/G.993.2: 997-M1x-M.
– Class 997-M2x Annex B/G.993.2: 997E17-M2x-NUS0, 997E30-M2x-NUS0.
– Class 998-M1x Annex B/G.993.2: 998-M1x-A, 998-M1x-B, 998-M1x-NUS0.
– Class 998-M2x Annex B/G.993.2: 998-M2x-A, 998-M2x-M, 998-M2x-B, 998-M2x-NUS0, 998E17-M2x-NUS0, 998E17-M2x-NUS0-M, 998E30-M2x-NUS0, 998E30-M2x-NUS0-M.
– Class 998ADE-M2x Annex B/G.993.2: 998-M2x-A, 998-M2x-M, 998-M2x-B, 998-M2x-NUS0, 998ADE17-M2x-A, 998ADE17-M2x-B, 998ADE17-M2x-M, 998ADE17-M2x-NUS0-M, 998ADE30-M2x-NUS0-A, 998ADE30-M2x-NUS0-M.
– Class 998-B Annex C: POTS-138b, POTS-276b (C.2.1.1/G.993.2), TCM-ISDN (C.2.1.2/G.993.2).
– Class 998-CO Annex C/G.993.2: POTS-138co, POTS-276co (C.2.1.1/G.993.2).
– Class HPE-M1 Annex B/G.993.2: HPE17-M1-NUS0, HPE30-M1-NUS0, HPE1230-M1-NUS0, HPE1730-M1-NUS0.

Each class is designed such that the PSD levels of each limit PSD mask of a specific class are equal in their respective passband above 552 kHz.

One CLASSMASK parameter is defined per ITU-T G.993.2 Annex enabled in the XTSE. It selects a single PSD mask class per ITU-T G.993.2 Annex that is activated at the VTU-O. The coding is as indicated in Table 7-6.

Table 7-6 – Definition of values of CLASSMASK per ITU-T G.993.2 Annex

Parameter value	ITU-T G.993.2 Annex A	ITU-T G.993.2 Annex B	ITU-T G.993.2 Annex C
1	998	997-M1c	998-B
2		997-M1x	998-CO
3		997-M2x	
4		998-M1x	
5		998-M2x	
6		998ADE-M2x	
7		HPE	
NOTE – A single PSD mask class shall be selected per ITU-T G.993.2 Annex.			

4.2) Table 7-7

Replace Table 7-7 by the following:

Table 7-7 – Definition of bits of LIMITMASK for each CLASSMASK

Bit number	Profile class	PSD mask classes									
		Annex A	Annex B							Annex C	
		998 Annex A	998-M1x Annex B	998-M2x Annex B	998ADE-M2x Annex B	997-M1x Annex B	997-M1c Annex B	997-M2x Annex B	HPE-M1 Annex B	998-B Annex C	998-CO Annex C
Octet 1											
1	8	D-32	M1x-A	M2x-A	M2x-A		M1c-A-7			POTS-138b	POTS_138co
2	8	D-48	M1x-B	M2x-B	M2x-B					TCM-ISDN	POTS_276co
3	8			M2x-M	M2x-M	M1x-M				POTS_276b	
4	8		M1x-NUS0	M2x-NUS0	M2x-NUS0						
5	8										
6	8										
7	8										
8	8										
Octet 2											
1	8	D-64									
2	8	D-128									
3	8										
4	8										
5	8										

Table 7-7 – Definition of bits of LIMITMASK for each CLASSMASK

Bit number	Profile class	PSD mask classes									
		Annex A	Annex B							Annex C	
		998 Annex A	998-M1x Annex B	998-M2x Annex B	998ADE-M2x Annex B	997-M1x Annex B	997-M1c Annex B	997-M2x Annex B	HPE-M1 Annex B	998-B Annex C	998-CO Annex C
6	8										
7	8										
8	8										
Octet 3											
1	12	D-32	M1x-A	M2x-A	M2x-A					POTS-138b	POTS_138co
2	12	D-48	M1x-B	M2x-B	M2x-B					TCM-ISDN	POTS_276co
3	12			M2x-M	M2x-M	M1x-M				POTS_276b	
4	12		M1x-NUS0	M2x-NUS0	M2x-NUS0						
5	12										
6	12										
7	12										
8	12										
Octet 4											
1	12	D-64									
2	12	D-128									
3	12										
4	12										
5	12										

Table 7-7 – Definition of bits of LIMITMASK for each CLASSMASK

Bit number	Profile class	PSD mask classes									
		Annex A	**Annex B**							**Annex C**	
		998 Annex A	**998-M1x Annex B**	**998-M2x Annex B**	**998ADE-M2x Annex B**	**997-M1x Annex B**	**997-M1c Annex B**	**997-M2x Annex B**	**HPE-M1 Annex B**	**998-B Annex C**	**998-CO Annex C**
6	12										
7	12										
8	12										
Octet 5											
1	17	D-32		E17-M2x-NUS0	ADE17-M2x-A			E17-M2x-NUS0	17-M1-NUS0	POTS-138b	
2	17	D-48		E17-M2x-NUS0-M	ADE17-M2x-B					TCM-ISDN	
3	17				ADE17-M2x-NUS0-M					POTS_276b	
4	17				ADE17-M2x-M						
5	17										
6	17										
7	17										
8	17										
Octet 6											
1	17	D-64									
2	17	D-128									
3	17										
4	17										
5	17										

Table 7-7 – Definition of bits of LIMITMASK for each CLASSMASK

Bit number	Profile class	PSD mask classes									
		Annex A	Annex B							Annex C	
		998 Annex A	998-M1x Annex B	998-M2x Annex B	998ADE-M2x Annex B	997-M1x Annex B	997-M1c Annex B	997-M2x Annex B	HPE-M1 Annex B	998-B Annex C	998-CO Annex C
6	17										
7	17										
8	17										
Octet 7											
1	30	D-32		E30-M2x-NUS0	ADE30-M2x-NUS0-A			E30-M2x-NUS0	30-M1-NUS0	POTS-138b	
2	30	D-48		E30-M2x-NUS0-M	ADE30-M2x-NUS0-M				1230-M1-NUS0	TCM-ISDN	
3	30								1730-M1-NUS0	POTS_276b	
4	30										
5	30										
6	30										
7	30										
8	30										
Octet 8											
1	30	D-64									
2	30	D-128									
3	30										
4	30										
5	30										

Table 7-7 – Definition of bits of LIMITMASK for each CLASSMASK

Bit number	Profile class	PSD mask classes									
		Annex A	Annex B							Annex C	
		998 Annex A	998-M1x Annex B	998-M2x Annex B	998ADE-M2x Annex B	997-M1x Annex B	997-M1c Annex B	997-M2x Annex B	HPE-M1 Annex B	998-B Annex C	998-CO Annex C
6	30										
7	30										
8	30										
NOTE – All unassigned bits are reserved by ITU.											

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