TITLE **Merging the missing "997" values into the VDSL2 model**

PROJECT SpM-2 (study point SP2-10)

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STATUS for decision, and inclusion into SpM-2

1 Introduction

BT elaborated in TD26 of this meeting (074t26) on the "997" numbers that are currently lacking in the VDSL2 transmitter model for SpM-2. We appreciate this effort, and the proposed values are considered as "editorial" in nature since they are intended to be fully in line with the ITU standard. However, when trying to merge the numbers into the draft SpM-2 document, we observed several editorial issues that need a solution. The chosen convention of grouping values into a singled "sub-band" is sometimes a bit "weird", while several other choices appears to be superfluous.
In other words: some additional editorial effort will result in a significant simplification of these numbers.
The text below shows the merger. Everything in blue or red represent the proposed additions, but everything in red needs your special attention. The intention of this contribution is to highlight the problem and to have it resolved.

Start of literal text proposal

1.1.1 0.0.1 Pre-defined downstream tables for "PSD Band Constructor"

The PSD band constructor in building block #1 can be controlled via an arbitrary number of PSD bands. Pre-defined PSD bands for downstream transmission are summarized in table 2 to 6 and specified by means of breakpoints. Each PSD band has its own (unique) identifier (summarized in table 1), for convenient referencing. A full VDSL2 transmit signal can be built-up from a proper selection of these PSD bands. Examples of meaningful combinations can be found in table 13.
The values are constructed from the breakpoints of G993.2 masks [2], roughly by correcting 3.5dB difference between mask and template for in-band frequencies, and roughly by correcting the PSD according to the constraints in 1 MHz resolution bands for out-of-band frequencies. In addition, some of the pre-defined values are adjusted via a pragmatic compromise between simplicity and ITU details. The values associated with in-band frequencies are highlighted, for convenient interpretation of these tables.

Table 1: Summary of pre-defined PSD bands, for downstream.

~~downstream identifiers for PSD bands (Bandplan 998)~~	~~downstream identifiers for PSD bands (Bandplan 997)~~	~~Remarks on the naming convention~~
~~DS1L.A_998~~ ~~DS1L.B_998~~ ~~DS1U.M1_998~~ ~~DS1U.M2_998~~ ~~DS2.M1_998~~ ~~DS2.M2_998~~ ~~DS3_998.E17~~ ~~DS3_998.ADE17~~ ~~DS3_998.E30~~ ~~DS3_998.ADE30~~ ~~DS4_998.E30~~	~~Tables defining PSD bands suitable for band plan 997 are left for further study~~	~~L = (lower part, <2.2M), A = (over POTS, like in annex A of [5])~~ ~~L = (lower part, <2.2M), B = (over ISDN, like in annex B of [5])~~ ~~U = (upper part, >2.2M), M1=(name for regular mask)~~ ~~U = (upper part, >2.2M), M2=(name for boosted mask)~~ ~~M1=(name for regular mask)~~ ~~M2=(name for boosted mask)~~ ~~E17=(extended up to 17 MHz)~~ ~~E17=(extended up to 17 MHz)~~ ~~E30=(extended up to 30 MHz)~~ ~~E30=(extended up to 30 MHz)~~ ~~E30=(extended up to 30 MHz)~~
~~NOTE: ADE = Asymmetric Downstream Extension~~		

downstream identifiers for PSD bands	Remarks on the naming convention
Bandplan 998	
DS1L.A_998 DS1L.B_998 DS1U.M1_998 DS1U.M2_998	L = (lower part, <2.2M), A = (over POTS, like in annex A of [5]) L = (lower part, <2.2M), B = (over ISDN, like in annex B of [5]) U = (upper part, >2.2M), M1=(name for regular mask) U = (upper part, >2.2M), M2=(name for boosted mask)
DS2.M1_998 DS2.M2_998	M1=(name for regular mask) M2=(name for boosted mask)
DS3_998.E17 DS3_998.ADE17 DS3_998.E30 DS3_998.ADE30	E17=(extended up to 17 MHz) E17=(extended up to 17 MHz), ADE = Asymmetric Downstream Extension E30=(extended up to 30 MHz) E30=(extended up to 30 MHz), ADE = Asymmetric Downstream Extension
DS4_998.E30	E30=(extended up to 30 MHz)
Bandplan 997	
DS1L.A_997 DS1L.M_M1_997 DS1L.M_M2_997 DS1L_997.HPE	L = (lower part, <2.2M), A = (over POTS, like in annex A of [5]) L = (Lower part, <2.2M), M = (extended upstream, like in Annex M of [5]) M1 = (Name for regular mask) L = (Lower part, <2.2M), M = (extended upstream, like in Annex M of [5]) M2 = (Name for boosted mask) L = (Lower part, <2.2M), HPE = (High Pass Extension) This represents noise floor “NF_997” (at –100dBm/Hz), do we really need it ???
DS1U.A_997 DS1U.M_997 DS1U.M2_997 DS1U_997.HPE	U = (Upper part, >2.2M), A=(??) U = (Upper part, >2.2M), M=(??) U = (Upper part, >2.2M), M2 = (Name for boosted mask) U = (Upper part, >2.2M), HPE = (High Pass Extension) This represents noise floor “NF_997” (at –100dBm/Hz), do we really need it ???
DS2A_997 DS2M_997 DS2_997.HPE	A=(??) M=(??) HPE = (High Pass Extension)
DS3_997.E DS3_997.HPE	E=(Extended) E =(Extended), HPE = (High Pass Extension)
DS4_997.E17 DS4_997.E30 DS4_997.HPE17 DS4_997.HPE30	E17 = (Extended up to 17MHz) This represents noise floor “NF_997” (at –112dBm/Hz), do we really need it ??? E30 = (Extended up to 30MHz) HPE17 = (Extended up to 30MHz) HPE30 = (Extended up to 30MHz)

ED NOTE The definition of several bands does not take advantage of the algorithmic nature of the model. Those that do represent a level equal to the noise floor are superflouos, and I suggest to remove them. The HPE ones are not representing a contiguous frequency band, and are therefore nor representing a ***second***, or ***third*** band. I suggest to reshuffle them a bit so that DS2 is indeed a second band, and DS3 indeed a third one.

Table 2: Pre-defined PSD bands for DS1L (lower part of DS1).

f [Hz]	DS1L.A_998 *P* [dBm/Hz]	DS1L.B_998 *P* [dBm/Hz]
0	-100	-100
3999	-100	-100
4000	-96	-96
80000	-76	interp
101200	interp	-96
137999	-47.7	interp
138000	-40	interp
227110	interp	-65.5
275999	interp	-52
276000	interp	-40
1104000	-40	-40
1622000	-50	-50
2208000	-51.5	-51.5

f [Hz]	DS1L.A_997 *P* [dBm/Hz]	DS1L.M_M1_997 *P* [dBm/Hz]	DS1L.M_M2_997 *P* [dBm/Hz]	DS1L.A_M2_997 *P* [dBm/Hz]	DS1L_997.HPE *P* [dBm/Hz]
0	-100	-100	-100	-100	-100
3999	-100	-100	-100	-100	-100
4000	-96	-96	-96	-96	-100
80000	-76	-96	-96	-76	-100
101200	Interp	-96	-96	Interp	-100
137999	-53	Interp	Interp	-47.7	-100
138000	-53	Interp	Interp	-40	-100
227110	-53	-65.5	-65.5	-40	-100
275999	-53	-52	-52	-40	-100
276000	-53	-40	-40	-40	-100
1104000	-53	-40	-40	-40	-100
1622000	-53	-50	-50	-50	-100

ED NOTE The definition the band at the level noise floor is superfluous, and therefore lacks the simplicity offered by the algorithmic approach. By simply removing DS1L_997.HPE completely you get the same

Table 3: Pre-defined PSD bands for DS1U (upper part of DS1).

f [Hz]	DS1U.M1_998 *P* [dBm/Hz]	DS1U.M2_998 *P* [dBm/Hz]
2208001	-51.5	-51.5
2249000	-53	interp
2500000	-60	interp
3749999	-60	-54.7
3750000	-83.5	-83.5
3894760	-100	-100
3999999	-100	-100
4000000	-110	-110

f [Hz]	DS1U.A_997 P [dBm/Hz]	DS1U.M_997 P [dBm/Hz]	DS1U.M2_997 P [dBm/Hz]	DS1U_997.HPE P [dBm/Hz]
1622000	-53	-50	-50	-100
2208000	-53	-51.5	Interp	-100
2236000	-53	Interp	Interp	-100
2249000	-60	Interp	Interp	-100
2423000	-60	-56.5	Interp	-100
2500000	-60	-56.5	Interp	-100
2999999	-60	-83.5	-53.1	-100
3000000	-83.5	-100	-83	-100
3175000	-100	-100	-100	-100

ED NOTE The definition the band at the level noise floor is superfluous, and therefore lacks the simplicity offered by the algorithmic approach. By simply removing DS1U_997.HPE completely you get the same

Table 4: Pre-defined PSD bands for DS2.

f [Hz]	DS2.M1_998 P [dBm/Hz]	DS2.M2_998 P [dBm/Hz]
5055624	-110	-110
5055625	-100	-100
5199999	-83.5	-83.5
5200000	-60	-56.2
8499999	-60	-58.3
8500000	-83.5	-83.5
8644566	-100	-100
8644567	-112	-112

f [Hz]	DS2.A_997 P [dBm/Hz]	DS2.M2_997 P [dBm/Hz]	DS2_997.HPE P [dBm/Hz]
3175000	-100	-100	-100
3999999	-100	-100	-100
4000000	-110	-110	-110
4925000	-110	-110	interp
5099999	-83.5	-83.5	-110
5100000	-60	-56.1	-112
5200000 **superfluous?**	interp	Interp	interp
6875000	interp	Interp	-112
7049999	-60	-57.5	-83.5
7050000	-83.5	-83.5	-60
7225000	-112	-112	-60

ED NOTE The definition the band at the level noise floor is superfluous, and therefore lacks the simplicity offerd\ed by the algorithmic approach. By simply omitting them, and combine it with the relevant noise floor, you get the same

ED NOTE The definition of DS2_997.HPE is very weird. Shouldn't is be merged with DS3_997.HPE as a single band, by simply extending the frequencies in this table until it sinks below the noise floor. It **IS** indeed a second band, so re-specify it as a single band up to

Table 5: Pre-defined PSD bands for DS3.

f [Hz]	DS3_998.E17 *P* [dBm/Hz]	DS3_998.ADE17 *P* [dBm/Hz]	DS3_998.E30 *P* [dBm/Hz]	DS3_998.ADE30 *P* [dBm/Hz]
11855638		-112		-112
11855639		-100		-100
11999999		-83.5		-83.5
12000000		-60		-60
13855658	-112	interp	-112	interp
13855659	-100	interp	-100	interp
13999999	-83.5	interp	-83.5	interp
14000000	-60	interp	-60	interp
17664000	-60	-60	interp	interp
21000000	-83.5	-83.5	interp	interp
21372373	-100	-100	interp	interp
21372374	-112	-112	interp	interp
21449999			-60	interp
21450000			-83.5	interp
21594776			-100	interp
21594777			-112	interp
24889999				-60
24890000				-83.5
25034810				-100
25034811				-112

f [Hz]	DS3_997.E14 *P* [dBm/Hz]	DS3_997.HPE *P* [dBm/Hz]
7225000	-112	-60
10124999	-112	-60
10125000	-112	-83.5
10300000	-112	-112
11825000	-112	-112
11999999	-83.5	-112
12000000	-60	-112
13825000	-60	-112
13999999	-60	-112
14000000	-83.5	-83.5
14175000	-112	-60
17664000	-112	-60

ED NOTE The definition the band at the level noise floor is superfluous, and therefore lacks the simplicity offerd\ed by the algorithmic approach. By simply omitting them, and combine it with the relevant noise floor, you get the same

ED NOTE The definition of DS3_997.HPE is very weird. I suggest to merge one variant it upto 10.3MHz with DS2_997.HPE and another variant up to 21.62Mhz since those comb iunations are indeed a second band

Table 6: Pre-defined PSD bands for DS4.

f [Hz]	DS4_998.E30 *P* [dBm/Hz]
24745527	-112
24745528	-100
24889999	-83.5
24890000	-60
29999999	-60
30000000	-83.5
30096499	-100
30096500	-112

f [Hz]	DS4_997.E17 *P* [dBm/Hz]	DS4_997.E30 *P* [dBm/Hz]	DS4_997.HPE *P* [dBm/Hz]	DS4_997.HPE30 *P* [dBm/Hz]
17664000	-112	-112	-60	-60
19325000	-112	-112	Interp	-60
19499999	-112	-83.5	Interp	-60
19500000	-112	-60	Interp	-60
21000000	-112	-60	-83.5	-60
21449999	-112	-60	-112	-60
21450000	-112	-60	-112	-83.5
21625000	-112	-60	-112	-112
24715000	-112	-60	-112	-112
24889999	-112	-60	-112	-83.5
24890000	-112	-60	-112	-60
26999999	-112	-60	-112	-60
27000000	-112	-83.5	-112	-60
27175000	-112	-112	-112	-60
29999999	-112	-112	-112	-60
30000000	-112	-112	-112	-83.5
30175000	-112	-112	-112	-112

ED NOTE The definition of DS4_997.HPE is very weird. I suggest to merge it with some DS3 band to make such combination indeed a third band.

ED NOTE The definition of DS4_997.HPE30 is very weird. I suggest to merge it up to 21.62MHz with DS3_997.HPE since such combination **IS** indeed a third band. Then the specification from 24.715 MHz becomes really a fourth band.

1.1.2 0.0.2 Pre-defined upstream tables for “PSD Band Constructor”

The PSD band constructor in building block #1 can be controlled via an arbitrary number of PSD bands. Pre-defined PSD bands for upstream transmission are summarized in table 8 to 12 and specified by means of breakpoints. Each PSD bands has its own (unique) identifier (summarized in table 7), for convenient referencing. A full VDSL2 transmit signal can be built-up from a proper selection of these PSD bands. Examples of meaningful combinations can be found in table 13.
The values are constructed from the breakpoints of G993.2 masks [2], roughly by correcting 3.5dB difference between mask and template for in-band frequencies, and roughly by corrected the PSD according to the constraints in 1 MHz resolution bands for out-of-band frequencies. In addition, some of the pre-defined values are adjusted via a pragmatic compromise between simplicity and ITU details.

Table 7: Overview of pre-defined PSD bands for upstream.

~~upstream identifiers for PSD bands (Bandplan 998)~~	~~upstream identifiers for PSD bands (Bandplan 997)~~	~~Remarks on the naming convention~~
~~US0.A_998~~ ~~US0.B_998~~ ~~US0.M_998~~ ~~US1.M1_998~~ ~~US1.M2_998~~ ~~US2.M1_998~~ ~~US2.M2_998~~ ~~US3_998~~ ~~US3_998.ADE~~ ~~US4_998~~	~~Tables defining PSD bands suitable for band plan 997 are left for further study~~	~~A = (like in annex A of [5], for over POTS)~~ ~~B = (like in annex B of [5], for over ISDN)~~ ~~M = (like in annex M of [5])~~ ~~M1=(name for regular mask)~~ ~~M2=(name for boosted mask)~~ ~~M1=(name for regular mask)~~ ~~M2=(name for boosted mask)~~
~~NOTE: ADE = Asymmetric Downstream Extension~~		

upstream identifiers for PSD bands	Remarks on the naming convention
Bandplan 998	
US0.A_998 **US0.B_998** **US0.M_998**	A = (like in annex A of [5], for over POTS) B = (like in annex B of [5], for over ISDN) M = (like in annex M of [5])
US1.M1_998 **US1.M2_998**	M1=(name for regular mask) M2=(name for boosted mask)
US2.M1_998 **US2.M2_998**	M1=(name for regular mask) M2=(name for boosted mask)
US3_998 **US3_998.ADE**	ADE = (Asymmetric Downstream Extension)
US4_998	
Bandplan 997	
US0.A_997 **US0.M_997**	A = (like in annex A of [5], for over POTS) M = (like in annex M of [5])
US1.M1_997 **US1.M2_997**	M1 = (Name for regular mask) M2 = (Name for boosted mask)
US2.M1_997 **US2.M2_997** **US2_997.HPE**	M1 = (Name for regular mask) M2 = (Name for boosted mask) HPE = (High Pass Extension)
US3_997.E17 **US3_997.E30** **US3_997.HPE**	E17 = (Extended to 17.664MHz) E30 = (Extended to 30MHz) HPE = (High Pass Extension)
US4_997.E30 **US4_997.HPE30**	E30 = (Extended to 30MHz) HPE30 = (Extended to 30MHz)

The HPE ones are not representing a contiguous frequency band, and are therefore nor representing a second band. I suggest to merge US2_997.HPE and US3_997.HPE so that DS2 is indeed a second band.

Table 8: Pre-defined PSD bands for US0.

f [Hz]	US0.A_998 *P* [dBm/Hz]	US0.B_998 *P* [dBm/Hz]	US0.M_998 *P* [dBm/Hz]
0	-100	-100	-100
3999	-100	-100	-100
4000	-96	-96	-96
25875	-38	-96	-41
50000	interp	-93.5	interp
80000	interp	-85.3	interp
120000	interp	-38	interp
138000	-38	interp	interp
243000	-96.7	interp	interp
276000	interp	-38	-41
405125	-100	interp	interp
486810	interp	interp	-100
501500	interp	-100	interp
686000	-100	-100	-100

f [Hz]	US0.A_997 *P* [dBm/Hz]	US0.M_997 *P* [dBm/Hz]
0	-100	-100
3999	-100	-100
4000	-96	-96
25875	-38	-41
50000	-38	-41
80000	-38	-41
120000	-38	-41
138000	-38	-41
225000	Interp	-41
243000	-96.7	-41
276000	Interp	-41
493410	Interp	-100
686000	-100	-100
282500	-100	-100

ED NOTE Do we really need the (red) values at 50, 80 and 120 kHz?. It is superfluous, since interpolation gives you the same results. The frequency “282500” is probably wrong, but since ity is at the noise floor you can skip it. The same applies for frequency “686000” and “0”

Table 9: Pre-defined PSD bands for US1.

f [Hz]	US1.M1_998 *P* [dBm/Hz]	US1.M2_998 *P* [dBm/Hz]
3575001	-100	-100
3605175	-100	-100
3749999	-83.5	-83.5
3750000	-60	-54.7
5199999	-60	-56.2
5200000	-83.5	-83.5
5344693	-100	-100
5344694	-112	-112

f [Hz]	US1.M1_997 *P* [dBm/Hz]	US1.M2_997 *P* [dBm/Hz]
2825000	-100	-100
2999999	-83.5	-83.5
3000000	-60	-53.8
3575000	-60	Interp
3750000	-60	Interp
5099999	-60	-56.1
5100000	-83.5	-83.5
5275000	-112	-112

ED NOTE Do we really need the (red) values at 3.575 and 3.75 MHz?. It is superfluous, since interpolation gives you the same results

Table 11: Pre-defined PSD bands for US2 (<12 MHz).

f [Hz]	US2.M1_998 *P* [dBm/Hz]	US2.M2_998 *P* [dBm/Hz]
8355624	-112	-112
8355625	-100	-100
8499999	-83.5	-83.5
8500000	-60	-58.3
10000000	interp	-59
12000000	-60	-59
12000001	-83.5	-83.5
12144761	-100	-100
12144762	-112	-112

f [Hz]	US2.M1_997 *P* [dBm/Hz]	US2.M2_997 *P* [dBm/Hz]	US2_997.HPE *P* [dBm/Hz]
5275000	-112	-112	-112
6875000	-112	-112	-112
7049999	-83.5	-83.5	-112
7050000	-60	-57.5	-112
8325000	Interp	Interp	-112
9950000	Interp	Interp	-112
10124999	Interp	-59	-83.5
10125000	Interp	Interp	-60
11999999	-60	-59	Interp
12000000	-83.5	-80	Interp
12175000	-112	-112	-60

ED NOTE The definition the band at the level noise floor (-112 dBm/Hz) is superfluous, and therefore lacks the simplicity offered by the algorithmic approach. By simply omitting them, and combine it with the relevant noise floor, you get the same. The frequencies in red can then be removed as well

ED NOTE The definition of US3_997.HPE is very weird because it does stop at the high end. I suggest to merge it US3_997.HP, since that combination is indeed a second band

Table 12: Pre-defined PSD bands for US3 and US4 (>12 MHz).

f [Hz]	US3_998 *P* [dBm/Hz]	US4_998 *P* [dBm/Hz]	US3_998.ADE *P* [dBm/Hz]
10350000	-112		
10350001	-100		
11999999	-83.5		
12000000	-60		
14000000	-60		
14000001	-83.5		
14144781	-100		
14144782	-112		
21305249		-112	
21305250		-110	
21449999		-83.5	
21450000		-60	
24745847		interp	-112
24745848		interp	-100
24889999		-60	-83.5
24890000		-83.5	-60
25034810		-100	interp
25034811		-112	interp
29999999			-60
30000000			-83.5
30096499			-100
30096500			-112

f [Hz]	US3_997.HPE *P* [dBm/Hz]	US3_997.E17 *P* [dBm/Hz]	US3_997.E30 *P* [dBm/Hz]	US4_997.HPE30	US4_997.E30
12175000	-60	-112	-112		
13825000	-60	-112	-112		
13999999	-60	-80	-80		
14000000	-83.5	-60	-60		
14175000	-112	Interp	Interp		
17664000	-112	-60	Interp		
19499999	-112	-83.5	-60		
19500000	-112	-83.5	-83.5		
19675000	-112	-112	-112	-112	-112
21275000				-112	-112
21449999				-83.5	-112
21450000				-60	-112
24889999				-60	-112
24890000				-83.5	-112
25065000				-112	-112
26825000				-112	-112
26999999				-112	-83.5
27000000				-112	-60
29999999				-112	-60
30000000				-112	-83.5
30175000				-112	-112

ED NOTE The definition of US3_997.HPE is very weird. I suggest to merge it US2_997.HP, and remove it from above table since that combination is indeed a second band

ED NOTE The definition the band at the level noise floor (-112 dBm/Hz) is superfluous, and therefore lacks the simplicity offered by the algorithmic approach. By simply omitting them, and combine it with the relevant noise floor, you get the same.

End of literal text proposal

1.2 References

Table 13: Full elaboration of the VDSL2 transmit PSD for a few profiles within limiting mask "B8-4".

[1] ETSI TS 101 270-1 (V1.3.1): "Transmission and Multiplexing (TM); Access transmission systems on metallic access cables; Very high speed Digital Subscriber Line (VDSL); Part 1: Functional requirements".

[2] ITU-T Recommendation G993.2: "Very High Speed Digital Subscriber Line 2 (VDSL2)", March 2006.

[3] ITU-T Recommendation G997.1: "Physical layer management for digital subscriber line (DSL) receivers", june 2006.

[4] ETSI TS 101 271 (draft): "Transmission and Multiplexing (TM); Access transmission systems on metallic access cables; Very high speed Digital Subscriber Line (VDSL2)".

[5] ITU-T Recommendation G.992.5: "Asymmetric digital subscriber line (ADSL) transceivers – extended bandwidth ADSL2 (ADSL2plus)".