Project: SDSL

Title: Evaluation of the European SDSL Test Loop Insertion Losses

Source: FTW

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Abstract:

This paper describes our re-evaluation of the SDSL test loop insertion losses. With the FSAN xDSL simulator, we have tried to verify the suggested insertion loss numbers in the current SDSL draft. Based on our simulations it was found that the resulting margins are always above the target values.

Distribution: ETSI STC TM6 working group members

Status: For information

1. Introduction

At, and directly after, the last meeting in Helsinki, a set of insertion losses was calculated and test loop lengths was derived from them. Based on these test loop lengths, given in [4], we evaluated the resulting actual margins for all test loops and bit rates for both symmetric and asymmetric nominal PSD masks [2] and FSAN noise models XA, XB, XC and XD [6]. For our simulations, we assumed a minimum required SNR of 27.71 dB, a coding gain of 5.1 dB and a background noise level of –140 dBm/Hz. We were using the ETSI crosstalk transfer functions as given in [1] and the extended (up to 2 MHz) cable parameters as given in [5] with linear interpolation between the given frequency points. The frequency resolution used was 100 Hz over the whole frequency range and the target margins 7.6 dB (6 dB + 1.6 dB implementation loss) for loops #2, #3, #4, #5, #7 and 8.1 dB (6 dB + 2.1 implementation loss) for loop #6 were assumed. In the tables below, the term 1.6, respectively 2.1, is already taken into account. The margin calculation follows the principle of ideal DFE margin calculation, based on the folded SNR.

2. Results

Tables 10.2 and 10.3 show the simulation results in terms of the minimum resulting margin at LT and NT node for noise models XA and XB, XC, XD respectively. The margin for the loop that have the minimum margin, for a given bitrate, are shown in bold. (They are the ones that determine the insertion loss.) Then among those marked margins, we have used *italic* (and blue) to indicate where more than 0.5dB margin exist.

Payload Bitrate [kb/s]	**f_T [kHz]**	**Y [dB] @f_T, @135Ω**	**resulting margin [dB] (target = 6 dB)**						**f_T [kHz]**	**Y [dB] @f_T, @135Ω**	**res. marg. [dB] (target = 6 dB)**
			#1	#2	#3	#4	#5	#7			#6
384	**150**	**43.0**	< 3	**6.39**	6.60	6.75	9.19	7.17	**115**	**40.5**	***7.59***
512	**150**	**37.0**	< 3	***6.53***	6.87	6.98	9.37	7.24	**115**	**35.0**	**6.28**
786	**150**	**29.0**	< 3	***7.15***	7.47	7.51	9.30	7.67	**275**	**34.5**	**6.38**
1024	**150**	**25.5**	< 3	**6.27**	6.49	6.51	7.67	6.55	**275**	**30.0**	***6.62***
1280	**150**	**22.0**	< 3	**6.32**	6.37	6.38	6.99	6.44	**275**	**26.0**	***6.83***
1536	**150**	**19.0**	< 3	6.59	**6.41**	6.46	6.65	6.66	**250**	**21.5**	***6.77***
2048 (s)	**200**	**17.5**	< 3	6.35	6.33	6.36	6.67	**6.20**	**250**	**18.5**	***7.25***
2304 (s)	**200**	**15.5**	< 3	6.56	6.41	6.44	6.61	**6.22**	**250**	**16.5**	***7.74***
2048 (a)	**250**	**21.0**	< 3	**6.39**	6.61	6.62	7.40	6.63	**250**	**21.0**	***6.62***
2304 (a)	**250**	**18.0**	< 3	**6.27**	6.42	6.42	7.01	6.51	**250**	**18.0**	***7.39***

Table 10.2: Resulting margin for SDSL test loops and Noise Model A including self crosstalk corresponding to nominal PSD + 11.7 dB (89 Disturbers) assuming test loop lengths derived from the given insertion losses.

(s) symmetric nominal PSD masks
(a) asymmetric nominal PSD masks

Payload Bitrate [kb/s]	f_T [kHz]	Y [dB] @f_T, @135Ω	resulting margin [dB] (target = 6 dB)						f_T [kHz]	Y [dB] @f_T, @135Ω	res. marg. [dB] (target = 6 dB)
			#1	#2	#3	#4	#5	#7			#6
384	**150**	**50.0**	< 3	***6.70***	6.98	7.13	9.85	7.52	**115**	**47.5**	***7.73***
512	**150**	**44.0**	< 3	***6.56***	7.03	7.11	9.85	7.28	**115**	**41.5**	***6.76***
786	**150**	**35.5**	< 3	***7.21***	7.63	7.68	9.82	7.77	**275**	**42.0**	**6.39**
1024	**150**	**32.0**	< 3	**6.24**	6.52	6.54	8.03	6.68	**275**	**38.0**	**6.14**
1280	**150**	**28.0**	< 3	**6.28**	6.36	6.39	7.24	6.52	**275**	**33.5**	***7.66***
1536	**150**	**25.5**	< 3	6.51	**6.43**	6.46	6.77	6.43	**250**	**29.0**	***6.68***
2048 (s)	**200**	**24.0**	< 3	6.48	6.56	6.57	7.09	**6.13**	**250**	**25.5**	**6.34**
2304 (s)	**200**	**21.5**	< 3	7.04	7.03	7.03	7.29	**6.36**	**250**	**23.0**	***7.25***
2048 (a)	**250**	**28.0**	< 3	**6.44**	6.78	6.82	7.89	7.04	**250**	**28.0**	**6.34**
2304 (a)	**250**	**25.0**	< 3	**6.39**	6.59	6.62	7.37	6.63	**250**	**25.0**	**6.39**

Table 10.3.1: Resulting margin for SDSL test loops and Noise Model Noise B including self crosstalk corresponding to nominal PSD+ 7.1 dB (15 Disturbers) assuming test loop lengths derived from the given insertion losses.

(s) symmetric nominal PSD masks

(a) asymmetric nominal PSD masks

Payload Bitrate [kb/s]	f_T [kHz]	Y [dB] @f_T, @135Ω	resulting margin [dB] (target = 6 dB)						f_T [kHz]	Y [dB] @f_T, @135Ω	res. marg. [dB] (target = 6 dB)
			#1	#2	#3	#4	#5	#7			#6
384	**150**	**50.0**	< 3	***6.70***	6.98	7.13	9.85	7.52	**115**	**47.5**	***7.73***
512	**150**	**44.0**	< 3	***6.56***	7.03	7.11	9.85	7.28	**115**	**41.5**	***6.76***
786	**150**	**35.5**	< 3	***7.21***	7.63	7.68	9.82	7.77	**275**	**42.0**	**6.39**
1024	**150**	**32.0**	< 3	**6.24**	6.52	6.54	8.03	6.68	**275**	**38.0**	**6.14**
1280	**150**	**28.0**	< 3	**6.28**	6.36	6.39	7.24	6.52	**275**	**33.5**	***7.66***
1536	**150**	**25.5**	< 3	6.52	6.44	6.46	6.78	**6.43**	**250**	**29.0**	***6.69***
2048 (s)	**200**	**24.0**	< 3	6.48	6.56	6.57	7.09	**6.13**	**250**	**25.5**	**6.34**
2304 (s)	**200**	**21.5**	< 3	7.04	7.03	7.03	7.29	**6.36**	**250**	**23.0**	***7.25***
2048 (a)	**250**	**28.0**	< 3	**6.43**	6.50	6.54	7.63	6.58	**250**	**28.0**	**6.34**
2304 (a)	**250**	**25.0**	< 3	**6.39**	6.59	6.62	7.37	6.51	**250**	**25.0**	**6.39**

Table 10.3.2: Resulting margin for SDSL test loops and Noise Model Noise C including self crosstalk corresponding to nominal PSD+ 7.1 dB (15 Disturbers) assuming test loop lengths derived from the given insertion losses.

(s) symmetric nominal PSD masks

(a) asymmetric nominal PSD masks

Payload Bitrate [kb/s]	f_T [kHz]	Y [dB] @f_T, @135Ω	resulting margin [dB] (target = 6 dB)						f_T [kHz]	Y [dB] @f_T, @135Ω	res. marg. [dB] (target = 6 dB)
			#1	#2	#3	#4	#5	#7			#6
384	**150**	**50.0**	< 3	***6.58***	6.86	7.02	9.70	7.37	**115**	**47.5**	***7.52***
512	**150**	**44.0**	< 3	***6.62***	7.06	7.15	9.81	7.30	**115**	**41.5**	***6.88***
786	**150**	**35.5**	< 3	***7.71***	8.07	8.12	10.15	8.24	**275**	**42.0**	***7.64***
1024	**150**	**32.0**	< 3	***6.99***	7.20	7.23	8.62	7.40	**275**	**38.0**	***7.07***
1280	**150**	**28.0**	< 3	***7.23***	7.26	7.28	8.05	7.40	**275**	**33.5**	***8.59***
1536	**150**	**25.5**	< 3	7.67	7.54	7.57	7.81	***7.51***	**250**	**29.0**	***7.83***
2048 (s)	**200**	**24.0**	< 3	7.08	7.13	7.14	7.69	***6.67***	**250**	**25.5**	***7.22***
2304 (s)	**200**	**21.5**	< 3	7.93	7.89	7.90	8.21	***7.19***	**250**	**23.0**	***8.21***
2048 (a)	**250**	**28.0**	< 3	**6.31**	6.65	6.69	7.74	6.90	**250**	**28.0**	**6.21**
2304 (a)	**250**	**25.0**	< 3	***7.40***	7.60	7.63	8.36	7.64	**250**	**25.0**	***7.40***

Table 10.3.3: Resulting margin for SDSL test loops and Noise Model Noise D including self crosstalk corresponding to nominal PSD + 11.7 dB (89 Disturbers) assuming test loop lengths derived from the given insertion losses.

(s) symmetric nominal PSD masks
(a) asymmetric nominal PSD masks

The tables show that our results are always slightly above the target margins, just as we would like them to be. As the values in the original tables were rounded to the nearest 0.5 levels, we would expect the margin to be between 6 and 6.5, for the loop with minimum margin. We find that for low bit-rates (especially for 512 and 786) the insertion loss values in the current tables are a little too pessimistic.

We also note that there is, for some bitrates, more than 3dB extra margin for loop #5.

3. Conclusions

In this contribution, we have tried to verify the insertion loss values in the current SDSL standard. We are happy to confirm that they never give an excessively low margin. For some bit-rates and some loops, the values seem too pessimistic, but maybe this is OK.

4. References

[1] ETSI Document *TM6(98)08-r5, Transmission and Multiplexing (TM); Access transmission systems on metal access cables; Symmetrical single pair high bit rate Digital Subscriber Line (SDSL); Part 1: Functional Requirements*, December 1999, SDSL System requirements, most recent version from ETSI TM6 group.

[2] ETSI Document *TS-101-524-2, Transmission and Multiplexing (TM); Access transmission systems on metal access cables; Symmetrical single pair high bit rate Digital Subscriber Line (SDSL); Part 2: Transceiver Requirements*, May 2000, Version 1.1.1, SDSL System requirements, most recent version from ETSI TM6 group.

[3] Nordström T., D. Bengtsson, FSAN xDSL simulation tool, Version 2.0, 2000. Version 2.0 is available at <http://www.xdsl.ftw.at/xdslsimu/ >.

[4] Johnsson R., M. Kimpe, M. Tramm *SDSL performance testing*, ETSI TM6 Helsinki WD19R3, 2000.

[5] Van den Brink, R. *Extending the specification of SDSL testloops beyond 500 kHz*, ETSI TM6 Helsinki TD 18, 2000.

[6] Van den Brink, R. *Update of SDSL noise models, as requested by ETSI-TM6*, ETSI TM6 Edinburgh TD22, 2000.