TITLE **Self-crosstalk update of the SDSL noise models**

PROJECT SDSL

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ABSTRACT This contribution includes the self-crosstalk in the noise models for SDSL performance tests. This proposal is a refinement of TD20 (Villach), and is supported by a large number of operators that work together in FSAN.

1. Introduction

In TD20 [2] of the ETSI-TM6 Villach meeting, several FSAN operators proposed a noise model for SDSL, based on the methodology of TD27 [1] of the ETSI-TM6 Vienna meeting. Several key issues of the problem were solved in TD20 [2], including the spectral assumptions on individual disturbers, the combination method, and the FSAN adoption of the TD27 [1] approach to address the length-dependency of the FEXT. This proposal was incorporated in the description of the SDSL performance test [4].
In addition, the alien noise was proposed for three models, which differ in the underlying technology mix. It was also clearly stated that self noise (SDSL only) was not discussed yet, simply because the FSAN proposal ran out of time. This lack of self-crosstalk was also observed in [3].

In this updated contribution, the proposed noise models include self crosstalk. The rationale behind the models was unchanged, and the modifications are the following:

- Model A: Alien noise unchanged; Self noise added on top.
- Model B: Alien noise reduced to release wires for SDSL
- Model C: Alien noise reduced to release wires for SDSL
- Model D: Added for linecode evaluation purposes only.

2. FSAN Proposal

Four scenario's have been identified to be applied to SDSL testing. Each scenario results in a length dependent PSD description of noise models, one to be injected at the LT-side, and another to be injected at the NT-side of the SDSL modem link under test.
The revised technology mix is summarised below. For combining the individual disturbers into a combine noise spectrum, the FSAN combination method shall be used, as described in [2] and [4] . The FSAN crosstalk sum for four individual PSD's equals (P in W/Hz):

$$P = (P_1^{Kn} + P_2^{Kn} + P_3^{Kn} + P_4^{Kn})^{1/Kn}, \quad \text{at } K_n=1/0.6$$

- ***Technology mix of model A (high penetration scenario)***

P_0	SDSL	+ 11.7 dB (occupying about 90 wire pairs)
P_1	ISDN/2B1Q	+ 11.7 dB (occupying about 90 wire pairs)
P_2	HDSL/2B1Q (2-pair)	+ 9.6 dB (occupying about 40 wire pairs)
P_3	ADSL over POTS	+ 11.7 dB (occupying about 90 wire pairs)
P_4	ADSL over ISDN	+ 11.7 dB (occupying about 90 wire pairs)

- ***Technology mix of model B (medium penetration scenario)***

P_0	SDSL	+ 7.1 dB (occupying about 15 wire pairs)
P_1	ISDN/2B1Q	+ 6.0 dB (occupying about 10 wire pairs)
P_2	HDSL/2B1Q (2-pair)	+ 3.6 dB (occupying about 4 wire pairs)
P_3	ADSL-lite	+ 6.0 dB (occupying about 10 wire pairs)
P_4	ADSL over ISDN	+ 4.2 dB (occupying about 5 wire pairs)

- ***Technology mix of model C (legacy scenario)***

P_0	SDSL	+ 7.1 dB (occupying about 15 wire pairs)
P_1	ISDN/2B1Q	+ 6.0 dB (occupying about 10 wire pairs)
P_2	HDSL/2B1Q (2-pair)	+ 3.6 dB (occupying about 4 wire pairs)
P_3	ADSL-lite	+ 6.0 dB (occupying about 10 wire pairs)
P_4	ADSL over ISDN	+ 4.2 dB (occupying about 5 wire pairs)
P_5	ISDN-PRI/HDB3	+ 3.6 dB (occupying about 4 wire pairs)

- ***Technology mix of model D (reference scenario)***

P_0	SDSL	+ 10.1 dB (occupying about 49 wire pairs)

NOTE These numbers are a compromise found between several telcos and they **do not** reflect the actual environment in one specific network.

3. Calculated noise models

Each noise model is subdivided into two parts: downstream noise at the LT-side and upstream noise at the NT-side. The noise models address the PSD levels of generator G1 and G2, as defined in Permanent Document TM6(98)10 [4], for upstream testing. The PSD of G1 and G2 are to be interchanged when testing the opposite direction.

[XA.LT.#]: are downstream PSD's of ***alien*** crosstalk noise. They are specified in Table 1, in terms of break frequencies. Their spectral profiles originate from a mix of disturbers, as described in section 2. These spectral profiles, filtered by the two crosstalk coupling functions as specified in Permanent Document TM6(98)10 [4], will represent their contribution to the FEXT, while testing downstream transmission, and to the NEXT while testing upstream transmission.

XA.LT.A [Hz]	*135 W* [dBm/Hz]
1	–18.2
50 k	–18.2
75 k	–25.4
292 k	–25.4
330 k	–26.1
1104 k	–26.1
2.50 M	–66.2
4.55 M	–96.5
30 M	–96.5

XA.LT.B [Hz]	*135 W* [dBm/Hz]
1	–23.9
50 k	–23.9
75 k	–31.8
292 k	–31.8
330 k	–32.5
550 k	–32.5
610 k	–34.8
700 k	–35.4
1104 k	–35.4
4.55 M	–103
30 M	–103

XA.LT.C [Hz]	*135 W* [dBm/Hz]
1	–24.0
50 k	–24.0
75 k	–31.8
292 k	–31.8
330 k	–32.5
550 k	–32.5
610 k	–34.8
700 k	–35.3
1104 k	–35.3
1.85 M	–58.5
22.4 M	–103
30 M	–103

XA.LT.D [Hz]	*135 W* [dBm/Hz]
ALL	*ZERO*

Table 1: Break frequencies of the "XA.LT.#" PSD masks that specify noise spectra as used in Permanent Document TM6(98)10 [4]. The PSD masks are constructed with straight lines between these break frequencies, when plotted against a *logarithmic* frequency scale and a *linear* dBm scale.

[XA.NT.#]: are upstream PSD's of ***alien*** crosstalk noise. They are specified in Table 2, in terms of break frequencies. Their spectral profiles originate from a mix of disturbers, as described in section 2. These spectral profiles, filtered by the two crosstalk coupling functions as specified in Permanent Document TM6(98)10 [4], will represent their contribution to the NEXT, while testing downstream transmission, and to the FEXT while testing upstream transmission.

XA.NT.A [Hz]	*135 W* [dBm/Hz]
1	–18.2
50 k	–18.2
75 k	–25.2
275 k	–25.3
400 k	–40.5
600 k	–54.3
1.0 M	–71.5
2.75 M	–96.5
30 M	–96.5

XA.NT.B [Hz]	*135 W* [dBm/Hz]
1	–23.9
50 k	–23.9
66 k	–28.9
81 k	–30.5
100 k	–31.0
140 k	–31.0
156 k	–32.4
278 k	–32.4
380 k	–45.0
1.0 M	–77.5
2.8 M	–103
30 M	–103

XA.NT.C [Hz]	*135 W* [dBm/Hz]
1	–23.8
50 k	–23.8
75 k	–31.0
141 k	–31.0
155 k	–32.4
276 k	–32.4
430 k	–48.2
750 k	–45.4
1.04 M	–45.5
2.46 M	–63.6
23.5 M	–103
30 M	–103

XA.NT.D [Hz]	*135 W* [dBm/Hz]
ALL	*ZERO*

Table 2: Break frequencies of the "XA.NT.#" PSD masks that specify the alien noise spectra as used in Permanent Document TM6(98)10 [4]. The PSD masks are constructed with straight lines between these break frequencies, when plotted against a *logarithmic* frequency scale and a *linear* dBm scale.

The noise that the impairment generator injects into the test setup is frequency dependent, is dependent on the length of the testloop and is also different for downstream performance tests and upstream performance tests. Figure 1 illustrates this for the ***alien*** noise in the case that the length of testloop #1 is fixed at 3 km. Figure 2 illustrates this for various loop lengths in the case that ***alien*** noise model 'B' is applied. The self noise (of SDSL) shall be combined with this alien noise.

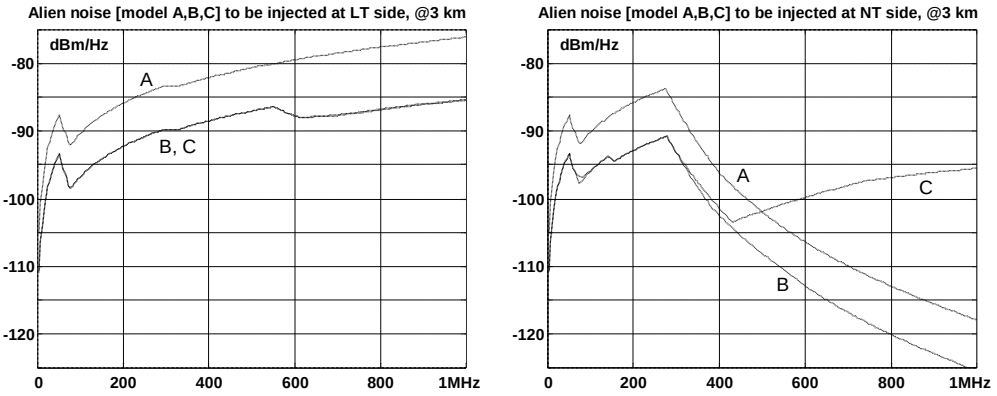

Figure 1: Example of noise spectra that are to be injected into the test setup, while testing SDSL systems. Its the noise, resulting from the three noise models for SDSL, in the case that the length of testloop #1 is fixed at 3 km.

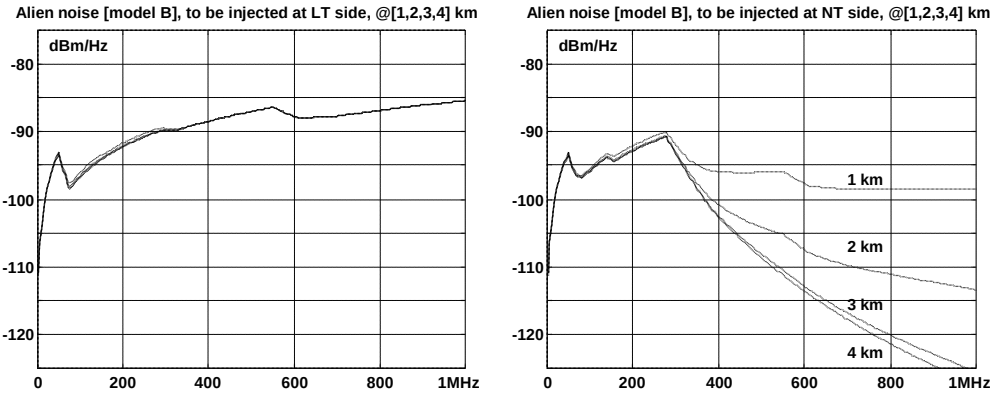

Figure 2: Example of noise spectra that are to be injected into the test setup, while testing SDSL systems. Its the noise, resulting from noise model B for SDSL, in the case that the length of testloop #1 varies from 1km to 4 km. This demonstrates that the noise is length dependent, to represent the FEXT in real access network cables.

4. References

[1] Rob van den Brink, KPN, *Proposal for SDSL performance tests*, ETSI-TM6 contribution TD27 (984t27a0), Vienna, Sept 1998.

[2] KPN/FSAN xDSL working group, *Revised noise models for SDSL*, ETSI-TM6 contribution TD20 (991t20a0), Villach, Feb 1999.

[3] Marc Kimpe, Josef Hausner, ADTRAN/SIEMENS, *Proposal to add self-NEXT in SDSL noise masks B and C,* ETSI-TM6 contribution TD39 (991t39a0), Villach, Feb 1999.

[4] Rob van den Brink, KPN, *Performance tests for SDSL and other long-range xDSL systems*, ETSI-TM6 permanent documents TM6(98)10, (980p10a0), Villach, Feb 1999.