Testing of Alien Crosstalk properties of an “as currently installed” category 6 cabling system

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1 Summary

This document describes the results of testing an existing category 6 rated cabling installation for both Alien NEXT and FEXT properties using an experimental field test capability. The intent of this study was to determine how Alien NEXT properties decline, as more disturber channels are included in the measurement. At this time, only one victim channels was analyzed. Additional experiments to be performed in the future will address how different victim channels perform. The set of measurements reported in this document are only a sample of “as currently installed” cat 6 cabling and must not be considered as “typical”.

2 Measurement methodology

All commercially available field testers have 4 measurement channels. An experimental adapter was used that splits up these channels over two (shielded) jacks. This experimental adapter is intended to conduct research only on Alien Crosstalk properties of installed cabling.

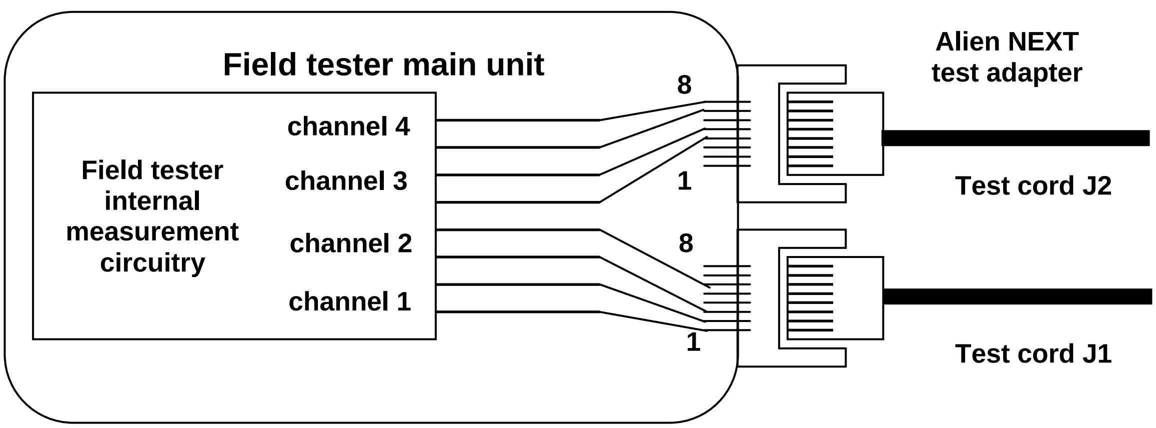

Figure 1: Principle of use of a regular field tester for Alien Crosstalk measurements.

A regular, one-ended NEXT measurement is performed by the field tester. The normal NEXT measurement yields results for the 12-36, 12-45, 12-78, 36-45, 36-78, and 45-78 wire pair combinations. The 12-36 and 45-78 wire pair combinations occur within one of the two jacks, and therefore do not reflect Alien Crosstalk properties. By changing test cords connectivity, all 16 pair-to-pair alien crosstalk measurements are obtained by making 4 changes in patch cords.

Patch cord	Test number and # patch cords used	Local	Remote
Straight through	1 (2) 2 (1) 4 (1)	12 36 45 78	12 36 45 78
12 to 45 and 36 to 78 78 to 36 and 45 to 12	2 (1) 3 (2) 4 (1)	12 36 45 78	45 78 12 36

Table 1: Connectivity of special patch cords needed to cover all PP Alien NEXT crosstalk wire pair combinations between a disturbed and disturber channel.

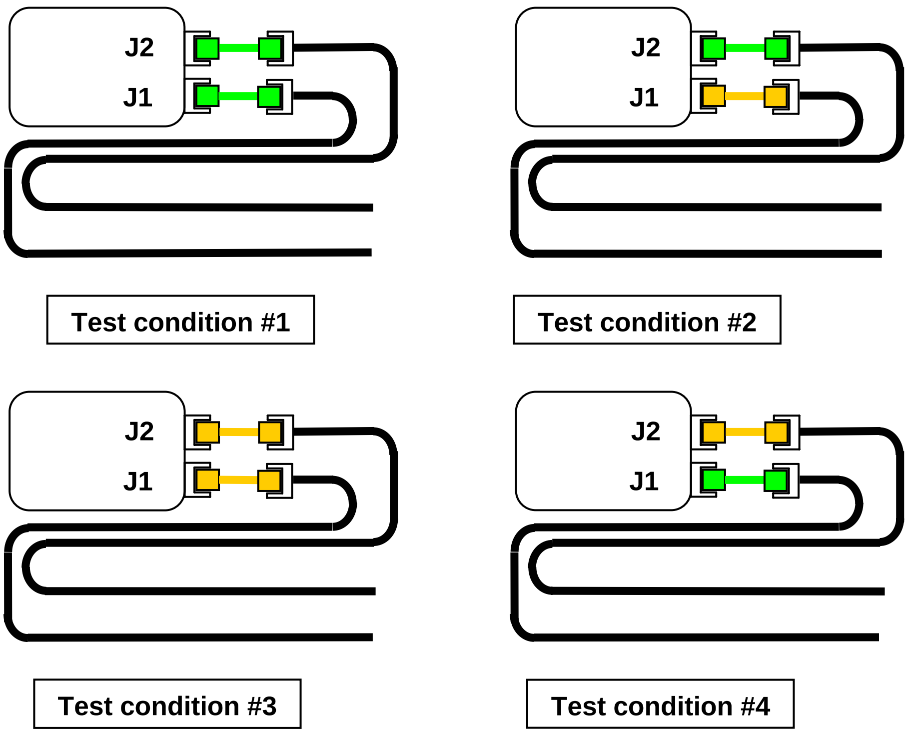

Table 2: Use of Alien NEXT interconnect cords and orientation during each of the 4 test steps.

After each measurement, the results are uploaded into a PC using special software to collect and organize the vast amount of data, as well as to compute the power sum results.

For the purpose of Alien FEXT measurements, one of the patch cords is connected to the local (victim) channel, while the other patch cord is connected to the remote end of a disturber channel.

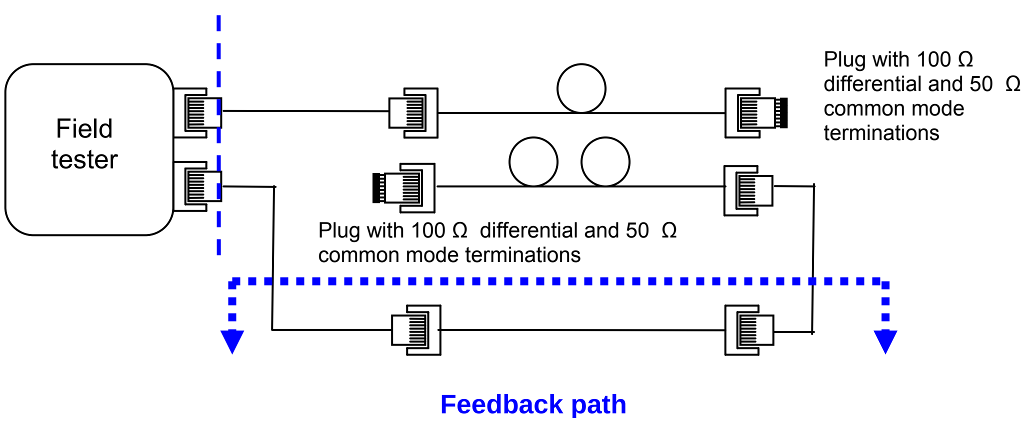

Figure 2: Schematic diagram for the Alien FEXT measurement.

The return channel is verified to have negligible Alien Crosstalk with either the victim or disturber channels. In our case, the routing was through a different patch panel in a different rack. In order to determine the Alien ELFEXT result, the measured Alien FEXT was reduced by the sum total of the insertion losses of the victim channel and feedback path. Since the channels were relatively short in this computer room application, the measurement floor properties of the field tester were adequate to perform the measurement. In cases where the round trip insertion loss becomes to high, one can extrapolate the expected 20 dB/decade in the PSAELFEXT frequency response to higher frequencies.

Once underway, it took approx. 2.5 minute for a full PSANEXT or PSAFEXT set of measurements for one victim cable to a disturber cable (one set is 4 measurements, each providing the PPANEXT or PPAFEXT results for 4 out of 16 wire pair combinations). We anticipate that this practically can be reduced by a factor of 5. Nevertheless, field alien crosstalk measurements are very time consuming and reliable test strategies need to be established.

3 Description of test installation

A computer room category 6 rated cabling installation was tested. This installation was approx. 3 years old. One victim channel of one patch panel consisting of 48 keystone connectors was measured (all 47 disturbers!). Telecommunications outlet #12 in the center of the patch panel was chosen as the victim channel. We are considering to measure some more victim channels along the edges of the patch panel, as well as one more in the center. See Table 3 for the numbering of the outlets in the patch panel and their orientation. The victim channel is shown in red. “Adjacent” disturber channels are shown in yellow.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48

Table 3: Lay-out of 48 connector patch panel.

Pictures that show the front of the rack and the cabling to the connectors are in Figure 3.

Note that the cables to each panel are nicely organized and bundled together. Additional patch panels have separate bundles, which eventually are routed together.

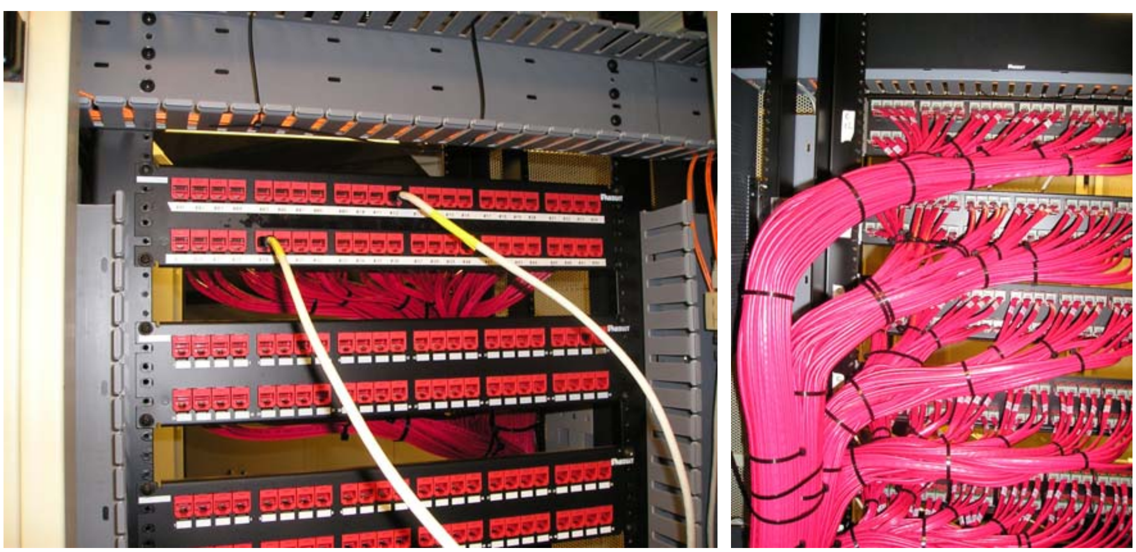

Figure 3: Pictures of the cabling tested.

4 Sample results

4.1 Overall PSANEXT

The overall PSANEXT result for victim channel #12 to all 47 disturber channels in the same cable bundle is shown in Figure 4.

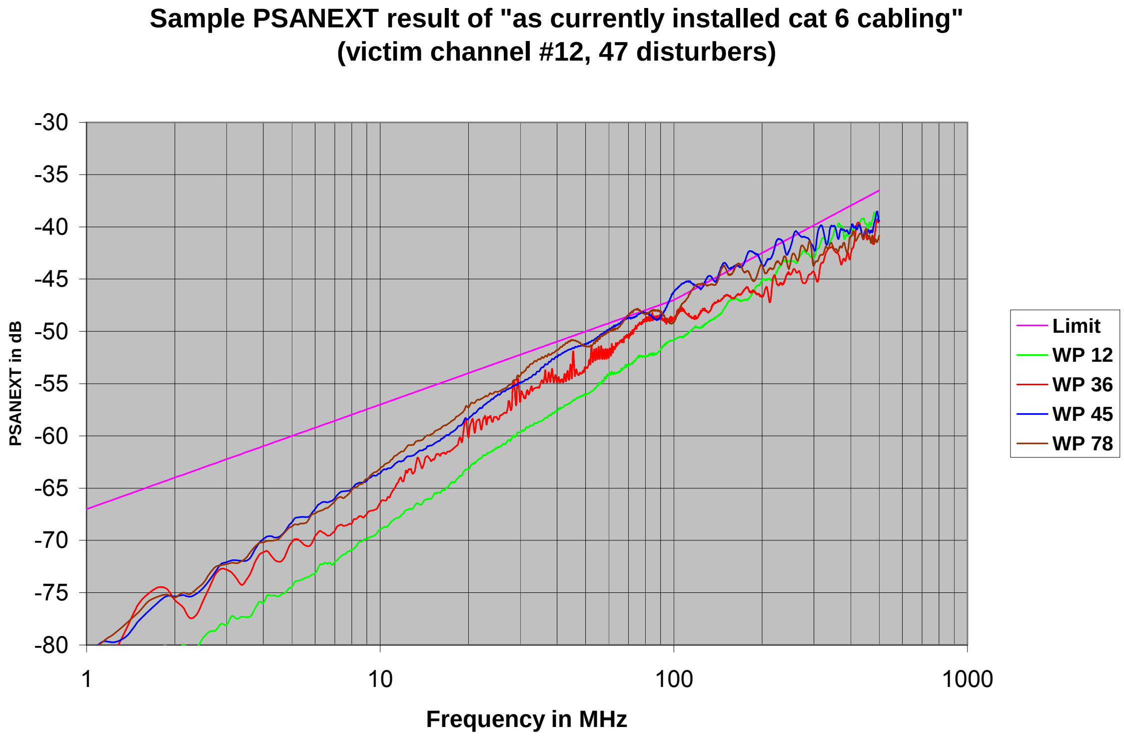

Figure 4: PSANEXT of victim channel 12 to all 47 disturber channels.

The PSANEXT limit is set to 47 dB @ 100 MHz. The performance appears marginal relative to the 55 m PSANEXT requirements. However, since the channel is shorter than 55 m (approx. 35 m), the channel likely will perform adequate for the proposed 10GBASE-T requirements as a result of considerably lower insertion loss properties.

4.2 Distribution of PSANEXT as a function of position of the disturber channel

Using the overall PSANEXT margin result as the reference, the individual disturber margin (relative to the standard pass/fail limit line with the PSANEXT limit equal to 47 dB @ 100 MHz) was observed. Of course the individual disturber margin is higher than the overall result PSANEXT margin. This margin was converted in a linear power value and plotted relative to each other. Figure 5 shows the relative Alien NEXT power contributed by the channels in the position they terminate on the patch panel. Note that the cables are routed towards the 24/48 position on the patch panel.

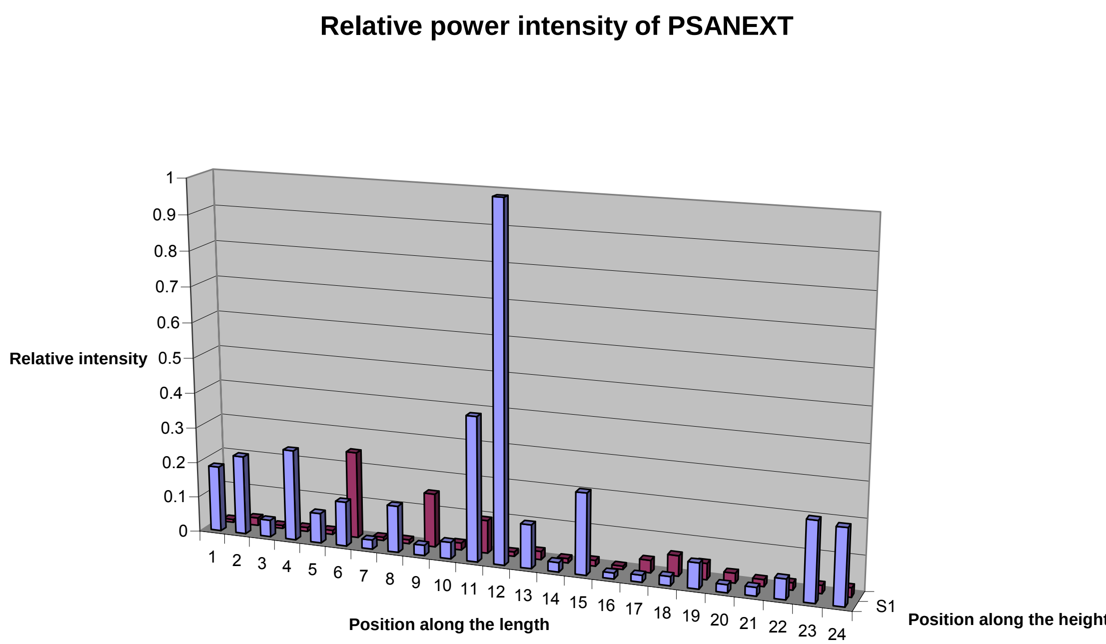

Figure 5: Relative PSANEXT contributions from disturber channels.

It is not overly convincing in this case, that the end-locations close to the channel on the patch panel are a good indicator of where most of the PSANEXT may originate from. Surprisingly enough, there are substantial sources of PSANEXT at the edge of the patch panel, away from the routing of the overall bundle. This may very well be a function of what portion of PSANEXT originates between the connectors in the patch panel. In this case, the patch panel (consisting of individual keystone jacks) appears to contribute very little PSANEXT.

If only the disturber channels (10, 11, 13, 14, and 34-38) adjacent to the victim channel (#12) were measured, the result would be a positive margin of 2.3 dB, while the result for all 47 disturbers is -1.2 dB. This suggests a “safety margin” of 3.5 dB in case only adjacent channels are measured.

4.3 Overall PSAELFEXT

The overall PSAELFEXT result for victim channel #13 to all 47 disturber channels in the same cable bundle is shown in Figure 6.

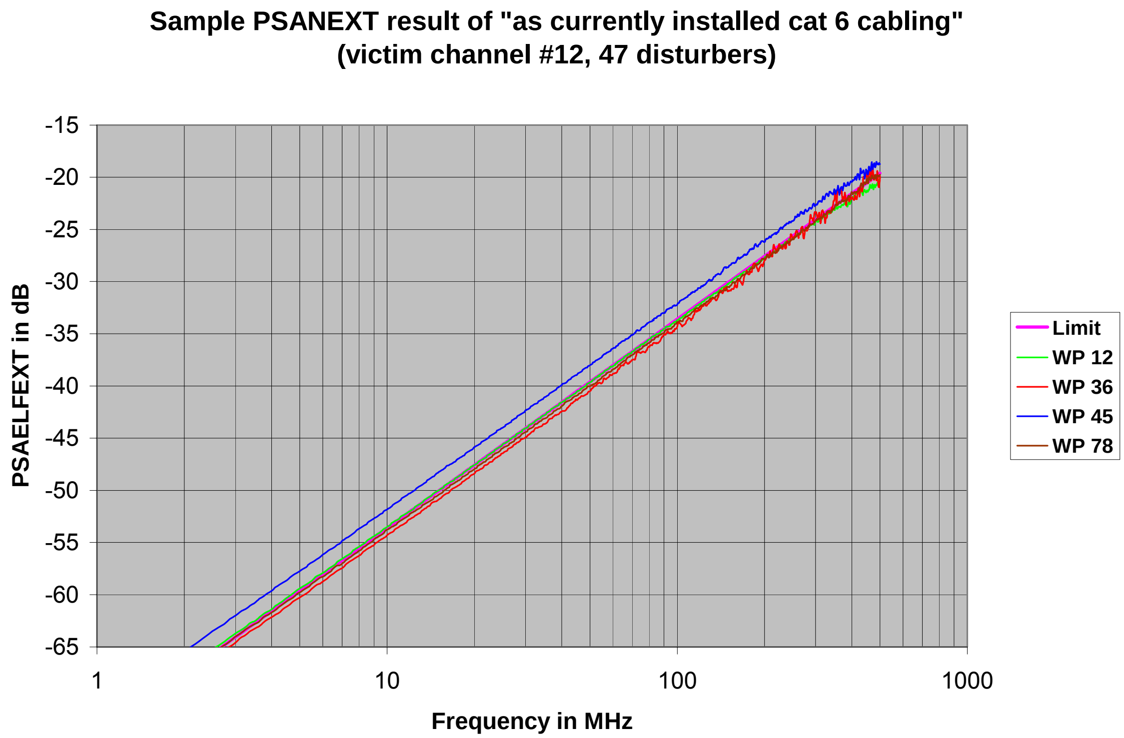

Figure 6: PSAELFEXT of victim channel 12 to all 47 disturber channels.

As a limit the proposed value for 55 m is used (33.6 dB @ 100 MHz). The result for the 45 wire pair fails the requirements by approx. 1.4 dB; the other wire pairs perform marginal relative to the requirements for 55 m. However, since the channel is considerably shorter than 55 m, the PSAELFEXT performance appears adequate for 10GBASE-T transmission.

4.4 Distribution of PSAELFEXT as a function of position of the disturber channel

Similar to what was done for the PSANEXT distribution of PSAELFEXT contributors, the PSAELFEXT power distribution was obtained by reading the PSAELFEXT @ 100 MHz for the worst wire pair. This was more convenient, since the expected slope in the frequency response is a constant 20 dB/decade.

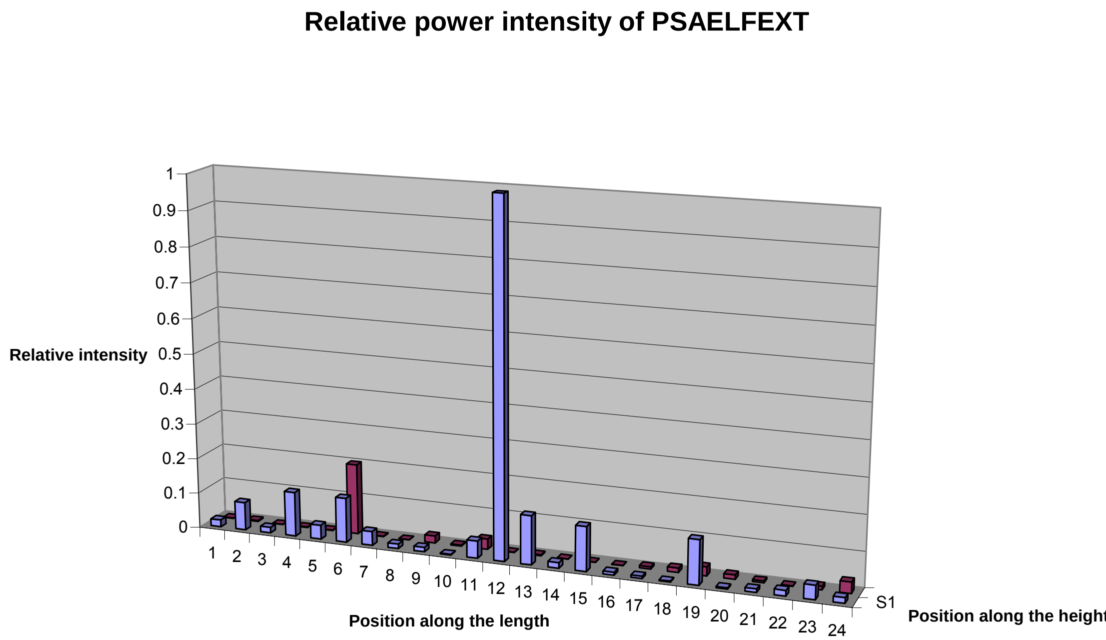

Figure 7: Relative PSAELFEXT contributions from disturber channels.

Also in the case for PSAELFEXT, it is not overly convincing that the end-locations close to the channel on the patch panel are a good indicator of where most of the PSAELFEXT may originate from. This may very well be a function of what portion of PSAELFEXT originates between the connectors in the patch panel.

If only the disturber channels (10, 11, 13, 14, and 34-38) surrounding the victim channel (#12) were measured, the result would be 45.5 dB @ 100 MHz, while the result for all 47 disturbers is 38 dB @ 100 MHz. This suggests a “safety margin” of 7.5 dB. This suggests that to limit the number of disturbers as much as is shown should not be recommended.

5 Conclusions

- The tested “as currently installed” category 6 channels do not meet or are marginal as far as 10GBASE-T alien crosstalk objectives are concerned. However, they will be able to meet 10GBASE-T transmission requirements since they channels are much shorter than 55 m. If the channels were 55 m, the conclusion would be that the results are marginal.
- It appears that significant Alien Crosstalk can originate from channels which do not terminate in close proximity of the termination of a victim channel.
- We still need to investigate the variability of PSANEXT dependent on the position on the patch panel. In order words, it may turn out that all possible victim channels exhibit almost the same PS Alien Crosstalk result.
- With assumptions for signal input power and environmental noise, regular field test results as well as alien crosstalk data could be processed to analyze the SNR for 10GBASE-T. The authors hope that a spreadsheet that computes the SNR can be developed and published.