A Review of PS AELFEXT Physical Layer specifications for 10GBASE-T Draft 1.4

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1 Summary

The equation for the PS AELFEXT constant contains a length dependent term. By its very nature, the length is directly related to insertion loss, and therefore this equation should be converted into a requirement of insertion loss by itself. In addition, insertion loss can be field tested accurately, while length cannot (the big variable is the assumption for Nominal Velocity of Propagation).

2 Approach to convert the length into an insertion loss requirement

Since the insertion loss of a link is dominated by the insertion loss of the cable, the relationship between insertion loss and length can be simplified to an equation like:

$$\mathrm{IL}_{\mathrm{link}} = \frac{\mathrm{length}}{100} \mathrm{K} \cdot \sqrt{\mathrm{f}} \tag{1}$$

One may obtain the value of constant K at 250 MHz. For nominal Class E performance requirements, it follows that the value of K is 2.28. Table 1 compares the approximation and limit values for some frequencies. Note this approximation is for 100 m, and the differences are scaled with length (and therefore are practically always smaller, except at very short lengths (where the relative influence if connector IL can be higher, but only if you have 4 connectors in the channels).

Frequency (MHz)	Limit IL 100 m (dB)	Approximation 100 m	
		Computed	Difference
10	6.56	7.21	-0.7
50	15.00	16.12	-1.1
100	21.71	22.80	-1.1
150	27.07	27.92	-0.9
200	31.72	32.24	-0.5
250	35.93	36.05	-0.1
300	39.82	39.49	0.3
350	43.47	42.65	0.8
400	46.93	45.60	1.3
450	50.23	48.37	1.9
500	53.40	50.98	2.4

Table 1: IL limit from standards and approximation comparison.

Per the approximation,

$$\mathrm{IL}_{\mathrm{link,250MHz}} = \frac{\mathrm{length}}{100} \mathrm{K} \cdot \sqrt{250} \tag{2}$$

$$\mathrm{length} = \frac{100 \cdot \mathrm{IL}_{\mathrm{link,250MHz}}}{\mathrm{K} \cdot \sqrt{250}} \approx 2.77 \cdot \mathrm{IL}_{\mathrm{link,250MHz}}. \tag{3}$$

Equation (55-28) in draft 1.4 can therefore be replaced by:

$$\text{PSAELFEXT\_constant} = 37 - \left(\frac{10\text{GBTIL}(250\text{MHz}) - \text{IL}(250\text{MHz})}{2.6} \right) - 10 \cdot \log_{10} \left(\frac{2.77 \cdot \text{IL}(250\text{MHz})}{100} \right) \qquad (4)$$

By using this equation, measured values for insertion loss can be entered into the requirement, and the requirements for PSAELFEXT established.

I plan to submit a comment to the draft. This document serves as background information.

3 Inconsistency of PS ALELFEXT constant for Class F and Augmented Cat 6

When substituting worst case insertion loss values in equation 55-28, one finds that the PS AELFEXT constant should be 36.2 dB rather than 37 dB. Hidden in the footnotes are statements that explain the discrepancy. The question arises whether simple straightforward assumptions should not be followed and accurate computed values be used..