Link Segment Specifications

George Zimmerman

CME Consulting

Link Segment Specification Proposal

– Utilize same form as Clause 55.7 and 113.7

– Base internal link segment characteristics off Cat5e channel specifications in TIA 568C.2, up to specified frequency

- Leave frequencies above 100MHz TBD for now

– Define Length Scaling for Insertion Loss

- Informative for now, useful for possible use-case definitions to come

– Define Alien Crosstalk PSANEXT & PSAACR-F in same form as Clause 55, but with offset constants

- Constants are TBD for now, form is from Eqns 55-23, 55-32
- Consider qualifying Alien Crosstalk similarly to ACMC (55.7.3.3)

– Solicit contributions / input from cabling standards bodies on:

- Frequency extension of link segment parameters to 250MHz
- Alien Crosstalk constants
- Alien Crosstalk qualification

Overview Clause, from 40.7.1, updated

- X.7.1 Cabling system characteristics
  - 2.5G/5GBASE-T requires 4-pair Class D cabling with a nominal impedance of 100 Ω, as specified in ISO/IEC 11801:2002. Operation on other classes of cabling may be supported if the link segment meets the requirements of X.7.
  - Additionally:
    a) 2.5GBASE-T is an ISO/IEC 11801-2002 Class D application, with additional installation requirements and transmission parameters specified in this clause.
    b) 5GBASE-T is an ISO/IEC 11801-2002 Class D application, with the additional installation requirements and transmission parameters specified in this clause, including extended frequency performance beyond that specified for Class D channels.
    c) The use of shielding is outside the scope of this specification.

Fill in link segment skeleton with TIA 568 C.2 Cat 5e parameters

- X.7.2.1 IL $1 \le f \le 100$ $1.02(1.967\sqrt{f} + 0.023f + \frac{0.05}{\sqrt{f}}) + 4 \cdot 0.04\sqrt{f}$

- X.7.2.3 RL $1 \le f < 20$: 17
  $20 \le f \le 100$: $17 - 10\log(f/20)$

- X.7.2.4.3 PSNEXT $1 \le f \le 100$

$$-20\log\left(10^{\frac{-(32.3-15\log(f/100))}{20}} + 2 \cdot 10^{\frac{-(40-20\log(f/100))}{20}}\right)$$

- X.7.2.4.6 PSELFEXT $1 \le f \le 100$

$$-20\log\left(10^{\frac{-(20.8-20\log(f/100))}{20}} + 4 \cdot 10^{\frac{-(32.1-20\log(f/100))}{20}}\right)$$

- Don't need pair-to-pair specifications – constrained by PS

- **TBD for 100MHz < f ≤ 250MHz**

Additional important parameters

- X.7.2.5 Propagation Delay (ns) :
  - Frequency extend to 250MHz

$$1 \le f \le 250 \qquad \left(534 + \frac{36}{\sqrt{f}}\right) + (4 \cdot 2.5)$$

- Question for study: Do we need TCL, ELTCL (balance parameters)
  - Not specified for Cat 5e, provided only for expected performance on Cat 6 in TIA 568 C.2
  - Cat 6 values:
    - TCL $\quad 1 \le f \le 250 \qquad 50 - 15\log(f)$

    - ELTCL $\quad \begin{array}{l} 1 \le f \le 30 \\ 30 < f \le 250 \end{array} \qquad \begin{array}{l} 30 - 20\log(f) \\ \text{n/s} \end{array}$

Length Scaling of IL & Internal parameters

– Length is *L* meters, number of connectors is *n*

  – IL $\leq \left(\frac{L}{100} + 0.02\right) \times \left(1.967\sqrt{f} + 0.023f + \frac{0.05}{\sqrt{f}}\right) + n * 0.04\sqrt{f}$

• Leave NEXT, RL, ELFEXT all length independent

  – Note, when modelling effect of ELFEXT, or PSACR-F, length dependence comes into play as $\log_{10}(L/100)$, but specification doesn't need this, as worst-case is 100M

  – Alien crosstalk specifications may vary with length

PSANEXT – Proposed form

- There is no specification for alien NEXT on Cat 5e or 6. Propose we assume the models shapes used for Cat6a with an offset, which is the tolerated PSANEXT – hence function of IL:

  - PSANEXT $\text{loss}_{2.5G} \geq X1_{2.5G}$ (IL) - $10\log_{10}(f/100)$, $f \leq$ 100 MHz

    Where $X1_{2.5G}(IL)$ is a function of insertion loss for 2.5G

  - PSANEXT $\text{loss}_{5G} \geq$
    $$\begin{cases} X1_{5G}(IL) - 10\log_{10}(f/100) & f \leq 100 \text{ MHz} \\ X1_{5G}(IL) - 15\log_{10}(f/100) & 100\text{MHz} < f \leq 250 \text{ MHz} \end{cases}$$
    Where $X1_{5G}(IL)$ is function of insertion loss for 5G

  $X1_{2.5G}(IL)$ and $X1_{5G}(IL)$ are TBD

PSAELFEXT (PSAACR-F) – Proposed form

- Same approach as PSANEXT, since it is unspecified, except that PSAACR-F already varies as a function of coupling length and is adjusted for IL, so the offsets are constants

  - PSAACR-F$_{2.5G}$ ≥ X2$_{2.5G}$ − 20log$_{10}$(f/100) , f < 100 MHz

    - Where X2$_{2.5G}$ is a constant TBD

  - PSAACR-F$_{5G}$ ≥ X2$_{5G}$ − 20log$_{10}$(f/100) , f < 250 MHz

    - Where X2$_{5G}$ is a constant TBD

Alien Crosstalk Qualification - thoughts

- Interplay of ANEXT & AFEXT is substantial at proposed frequencies for 2.5G/5GBASE-T.

- Recommend development of a lumped measurement based on Salz SNR – similar to Alien Crosstalk Margin Computation in 10GBASE-T

  - Relates IL to Alien Crosstalk
  - Allows tradeoffs of ANEXT & FEXT
  - Can be made environment-specific (different interferers & use-cases)
  - However, no cabling specification to compute 'margin' to! (perhaps a simpler calculation)

THANK YOU