Impedance balance requirements for 2.5G & 5GBASE-T link segments

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Supporters - ???

Recent Fluke Comment (Atlanta)

- ISO/IEC includes impedance balance requirements
- TIA 568 does not
- Both cabling standards are referenced for use in 802.3bz.
- 2.5G/5GBASE-T link segment should be explicate about impedance balance parameters so as to remove any ambiguity for equipment and system implementers.

ISO/IEC 11801:2002, Class D, Class E

Table 20 - Unbalance attenuation for channel

Class	Frequency MHz	Maximum unbalance attenuation dB
A	f = 0,1	30
B	f = 0,1and 1	45 @ 0,1 MHz; 20 @ 1 MHz
C	$1 \leq f \leq 16$	30 - 5log(f) f.f.s.
D	$1 \leq f \leq 100$	40 - 10log(f) f.f.s.
E	$1 \leq f \leq 250$	40 - 10log(f) f.f.s.
F	$1 \leq f \leq 600$	40 - 10log(f) f.f.s.

Note: The 2002 edition of 11801 has no regard for screened or unscreened cabling constructions.

ISO/IEC 11801 Class D, Ed. 2.2, 2011

Table 21 – TCL for channel for unscreened systems

Class	Frequency MHz	Minimum TCL [a] dB
A	$f = 0,1$	30
B	$f = 0,1$ $f = 1$	45 20
C	$1 \leq f \leq 16$	$30 - 5 \lg(f)$
D, E, E_A, F, F_A	$1 \leq f < 30$ $30 \leq f \leq$ NOTE [b]	$53 - 15\lg(f)$ $60,3 - 20\lg(f)$
NOTE This equation for TCL applies to upper frequency of the class.		
[a] *TCL* at frequencies that correspond to calculated values of greater than 40,0 dB shall revert to a minimum requirement of 40,0 dB. [b] TCL at frequencies above 250 MHz are for information only.		

ISO/IEC 11801 Class D, Ed. 2.2, 2011

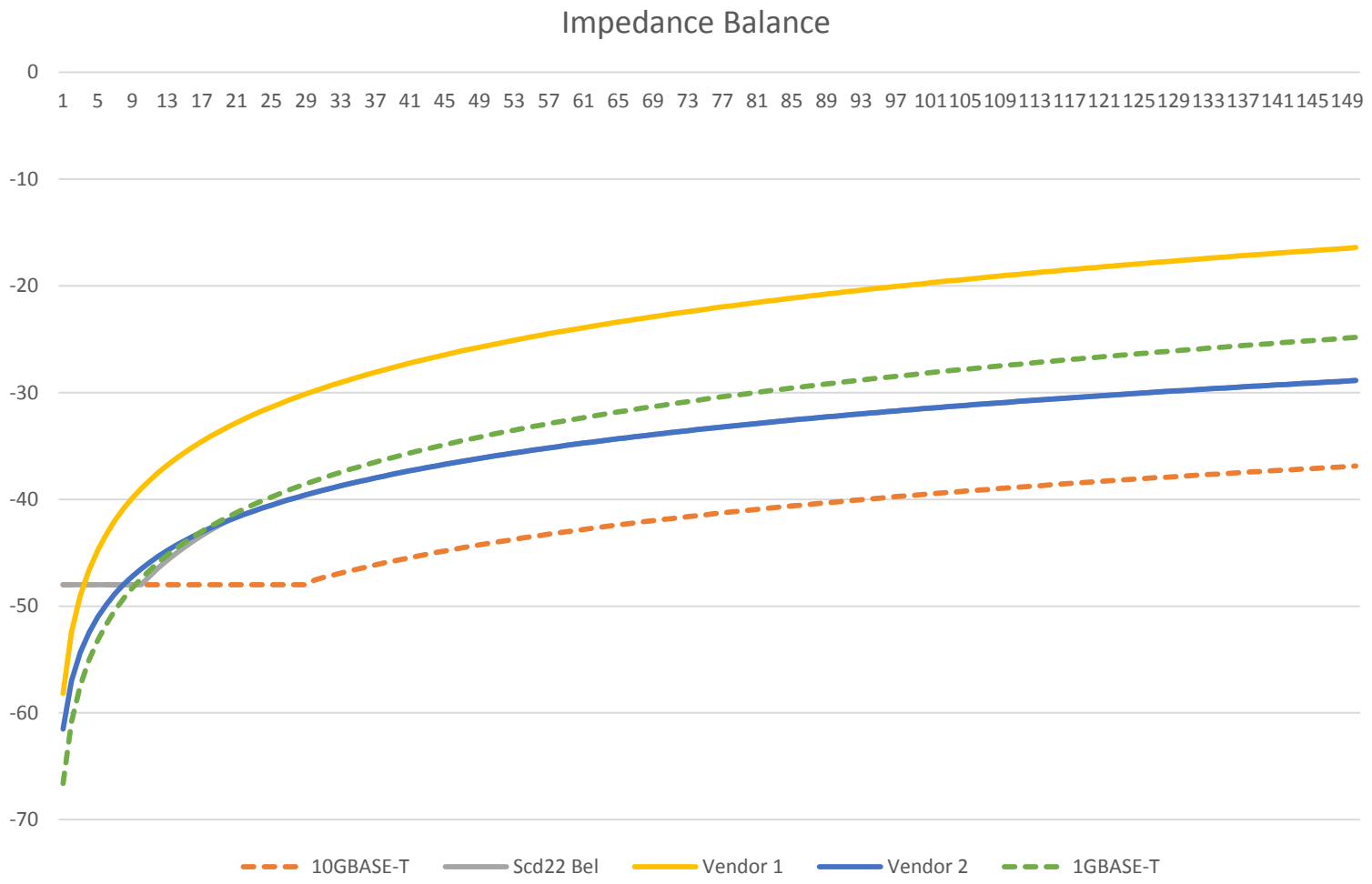
Table 22 – ELTCTL for channel for unscreened systems

Class	Frequency MHz	Minimum ELTCTL dB
D, E, E_A, F, F_A	$1 \leq f \leq 30$	$30 - 20\lg(f)$

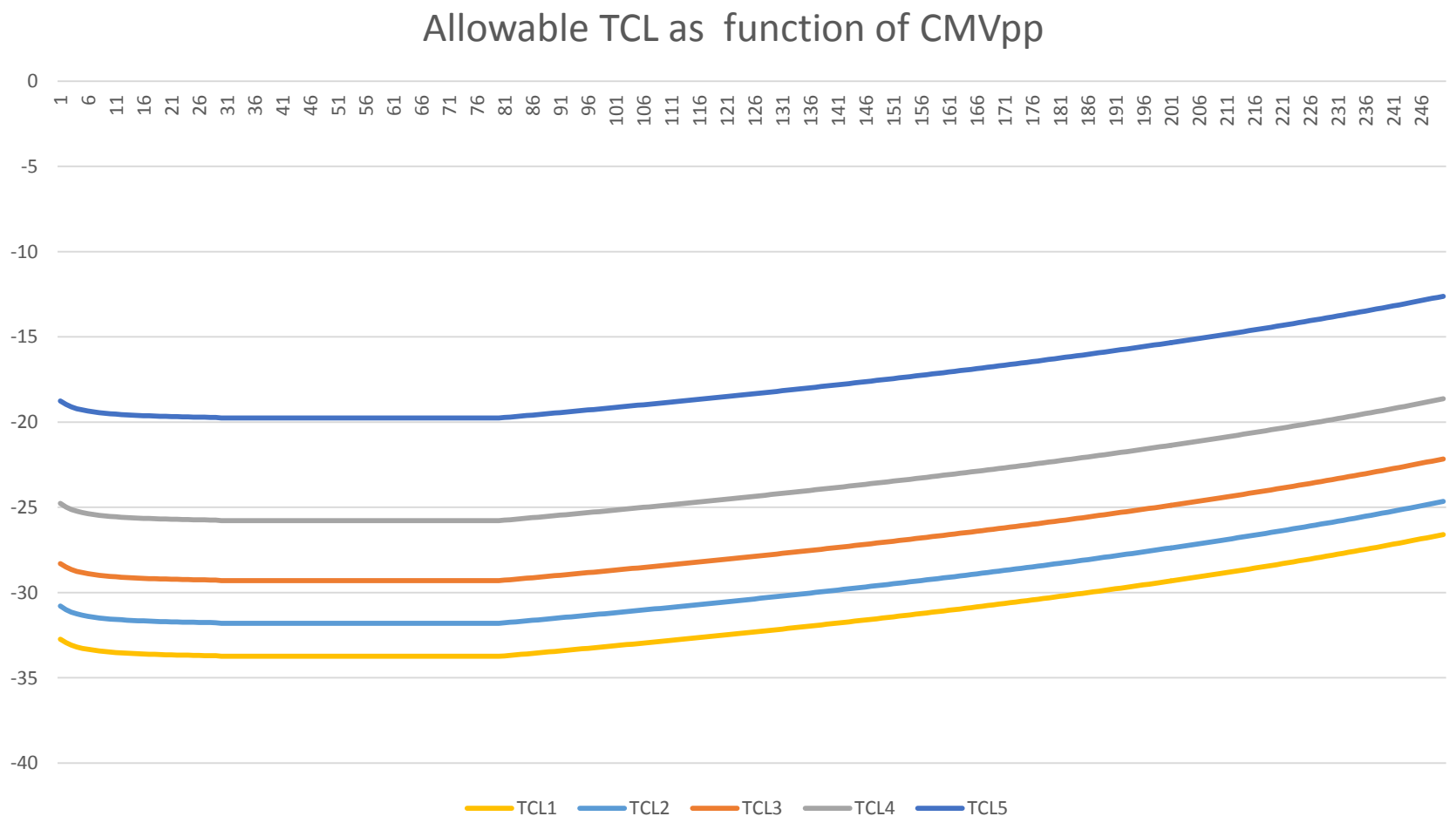
Additional considerations

- MDI has explicit impedance balance requirements (clause 126.8)
  - Historically these are derived to provide margin against the CM output voltage being sufficient to exceed the Class A emission limits (see Cobb_0705).
- The CMRR test has *implied* minimum mode conversion requirements for the media used in the test setup (Annex 113A)
  - The +6 dBm input voltage is similarly derived from immunity test limits (see Cobb_0505).
- Poorly balanced cabling can contribute to failing EMC tests.
- Prudent system design would seem to dictate that these minimums be compared to the link segment requirements.

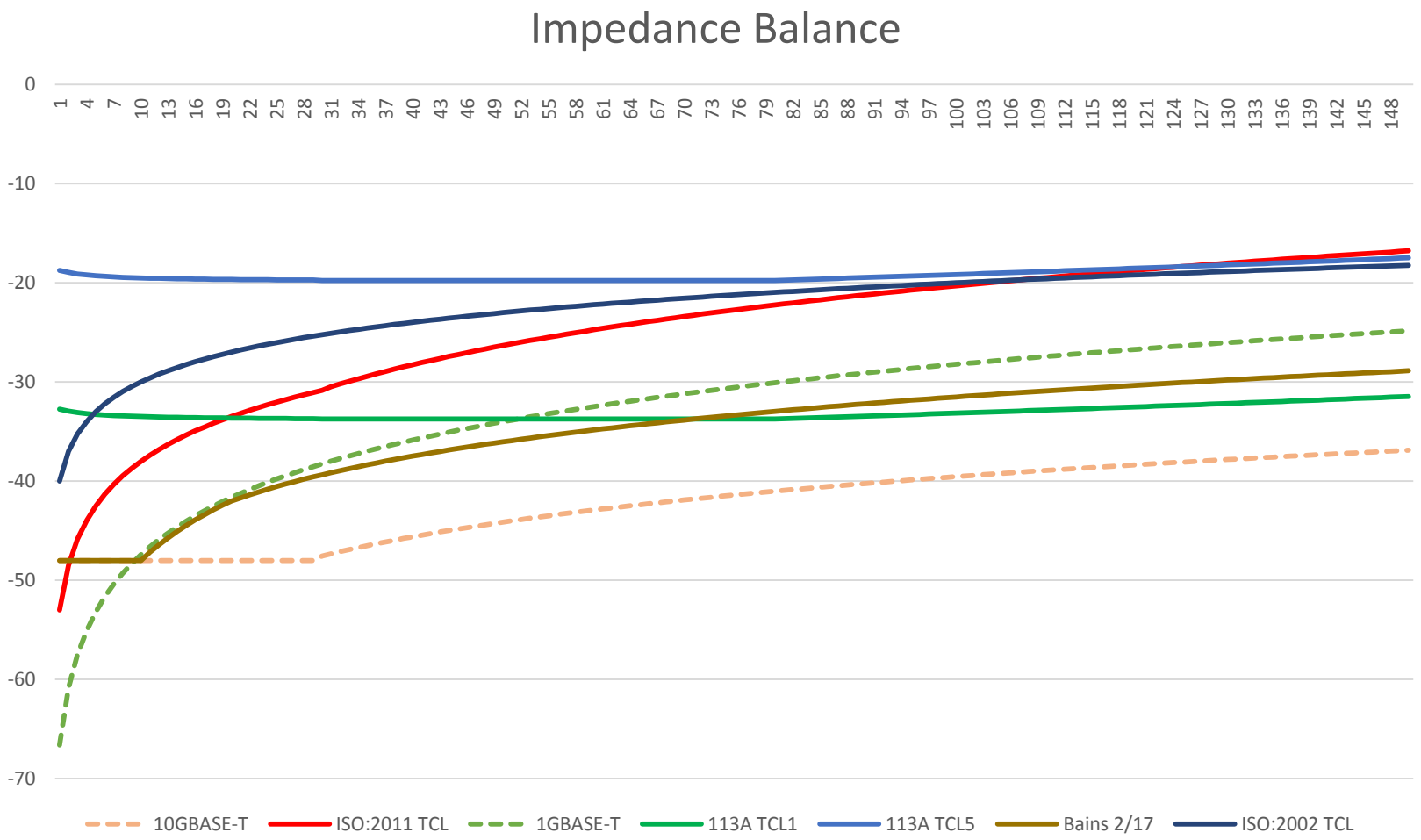
MDI Impedance Balance proposals



CMR Test – Implied link segment TCL



Compare Class D channel TCL



Conclusions

- Prudent system design would seem to dictate that impedance balance minimums be compared to the link segment requirements for TCL, in order to assure reliable operation of the PHY at speed. (We just did that.)
- I have no desire to throw out, or even challenge, the ISO limits. They are what they are.
- Personal experience: poorly balanced cabling will not hold a 1Gb/s link, let alone 2.5G or 5G transmission.
- Based on these comparisons, we have enough reason to at least make the ISO limits as an explicate minimum for 802.3bz, listed in clause 126.7.