Ethernet 106 Gb/s ERL Studies

For IEEE 802.3ck

Mar, 2019

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Agenda

- Motivation/Objectives
- Methodology to Derive Proposal
- Proposal: TX/RX and Channel ERL Specs and Parameters
- Reasons for Change & No-Change from 802.3cd

Motivations/Objectives

- Effective Return Loss (ERL) has been adopted as a new method/parameter to specify return loss for IEEE 802.3cd for 53 Gbps
- This investigation intends to determine the ERL values for 802.3ck BP for 106Gbps

Methodology to Derive ERL

- Obtain candidate ERL parameters and spec
  - Some parameters are scaled from 802.3cd ERL parameters
  - The other parameters are the same as 802.3cd ERL parameters
  - Reference to the relevant 802.3 clause 137 (53G BP)
- Evaluate candidate ERL with COM ref. XCVR and some channels
  - Evaluate TX/RX ERL with CEI-112G-LR COM ref. TX/RX including latest trending ref package
  - Evaluate channel ERL with 802.3ck contributed channels
- Determine the ERL parameters based on estimates

Tr Scaling to 106.25Gbps

- Tr = 18.9ps for 53.125Gbps (802.3cd spec.)
- Tr = 13.65ps for 106.25Gbps
  - It is not likely that rise/fall time becomes a half when data rate is doubled from 53.125Gbps to 106.25G.
  - Cd value of the COM package model is used to scale the Tr (130fF for 106.25Gbps vs 180fF for 53.125Gbps)

$$T_r(802.3ck) = 18.9ps \times \frac{130fF}{180fF} = 13.65ps$$

Sample Size N Scaling

- Assuming that DUT physical length (package size, channel length) remains to be the same as 53G-LR, while UI becomes half in ps.
- N for 106G is doubled from 53G to cover about the same physical length.

Estimated TX/RX ERL Values

COM TX/RX (incl pkg) Model	ERL [dB]
pkg_2seg_cd130_cp87_12mm.s2p	19.283
pkg_2seg_cd130_cp87_20mm.s2p	12.582
pkg_2seg_cd130_cp87_30mm.s2p	13.697

802.3cd spec is 15dB

- Worst case TX/RX ERL lowered to 12dB to make all the reference TX/RX models pass

ρ_x for Channel ERL

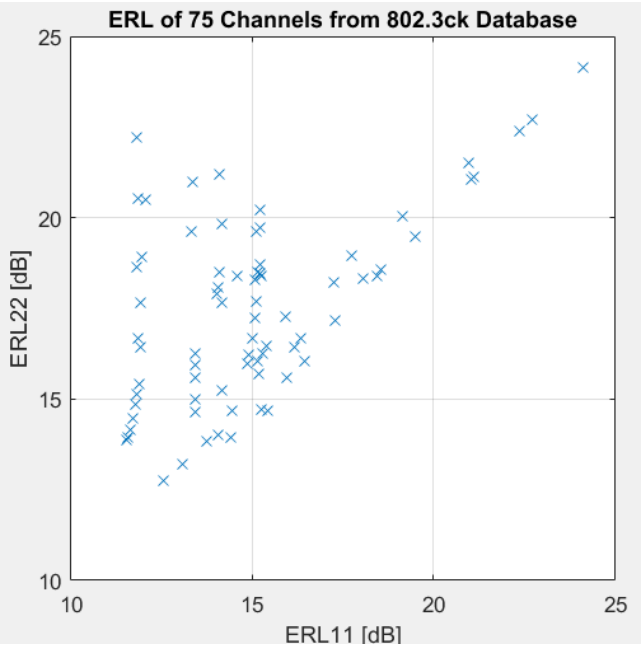
- Setting TX/RX ERL spec to 12dB, which corresponds to $\rho_x = 0.25$

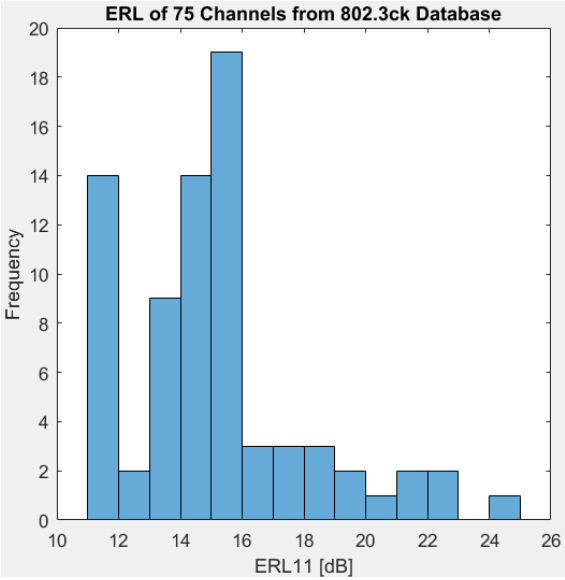
$$\rho_{x(channel)} = 10^{-\frac{ERL_{TX/RX}}{20}} = 10^{-\frac{12}{20}} = 0.25$$

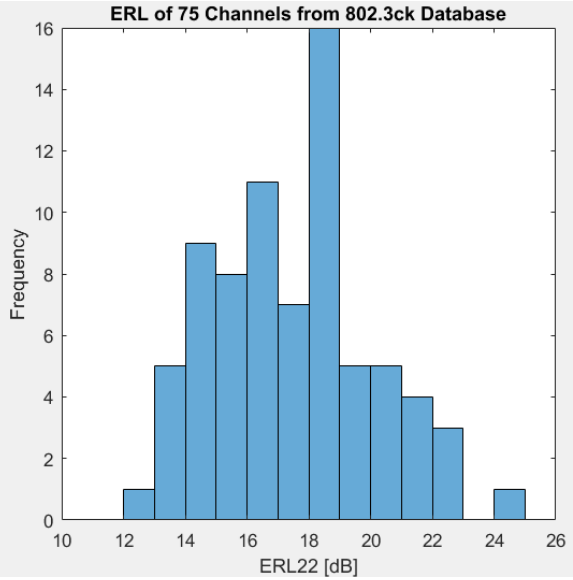
- No change of ρ_x value for TX/RX ERL because of no change of channel ERL spec

Channel ERL Estimates

- The ERLs of the 802.3ck channels are larger than 10dB with the proposed parameters and the TX/RX ERL spec of 12dB







β_x Value for ERL

- IL per unit length characteristic would not change much from 802.3cd
  - 802.3ck PCB/package trace IL would be better than 802.3cd at the same frequency
  - But 802.3ck Nyquist frequency is a double of 802.3cd
  - Therefore, there would not be significant change in 802.3ck IL per unit length at $f_{Nyquist}$ from 802.3cd

TX and RX ERL Proposal

- TX ERL at TP0a shall be greater than or equal to 12dB
- RX ERL at TP5a shall be greater than or equal to 12dB

Parameter	Symbol	Value	Units
Transition time associated with a pulse	T_r	0.0189	ns
Incremental available signal loss factor	β_x	1.7	GHz
Permitted reflection from a transmission line external to the device under test	ρ_x	0.32	—
Length of the reflection signal	N	100	UI

13.65 ps

200

Channel ERL Proposal

- Channel ERL at TP0 and at TP5 shall be greater than or equal to 10dB

Parameter	Symbol	Value	Units
Transition time associated with a pulse	T_r	0.0189	ns
Incremental available signal loss factor	β_x	1.7	GHz
Permitted reflection from a transmission line external to the device under test	ρ_x	0.18	—
Length of the reflection signal	N	1000	UI

13.65 ps

0.25

2000

Thank You !