ERL Studies for Ethernet 106Gbps Backplane (II)

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Intel

Outline

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

Methodology to Derive Proposal

- 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
  - No Grr and Gloss change from 802.3cd ERL
- Evaluate candidate ERL with COM ref. TX/RX and some channels
  - Evaluate TX/RX ERL with 802.3cd KR COM ref. TX/RX including new package models
    - New package models use new termination model proposed: http://www.ieee802.org/3/ck/public/adhoc/jun12_19/healey_3ck_adhoc_01_061219.pdf [1]
  - Evaluate channel ERL with 802.3ck channels
    - No floating tap, Nb=21 (=12 + 3*3) used
- Adjust the ERL parameters and/or spec if needed

Reason for N Change

- DUT physical length (package size, channel length) would not change much from 53G-KR while UI becomes about a half.
- Therefore, N for 106G is doubled from N for 53G to cover about the same physical length.

An ERL Spec Example from 802.3cd

Table 136–13—Transmitter and receiver ERL parameter values

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	0.3	—
Length of the reflection signal	N	300	UI

Reason for Tr Change

- Tr = 10ps for 106Gbps PAM4
  - Scaling “802.3cd-equivalent Cd value” of the COM package model
    - Equivalent Cd=90fF used below is not explicitly found in the new die model[1]

$$Tr[scaled\ from\ 802.3cd\ Tr\ for\ ERL] = 18.0ps \times \frac{90fF}{180fF} = 9.45ps \approx 10ps$$

Reason for TX/RX ERL Spec: No Change

- Worst case TX/RX ERL of COM reference TX/RX model is 15dB
  - Thanks to improved die load and increased DFE taps

Trace Length of New COM TX/RX Package Model [mm]	ERL [dB]
12	19.9
20	21.6
29	15.0
31	15.9

Reason for ρ_x Value: No Change for TX/RX and Channel ERL

- ρ_x value corresponds to the ERL spec of its counter part, and no ERL spec change for TX/RX and Channel

KR Channel List for ERL Analysis

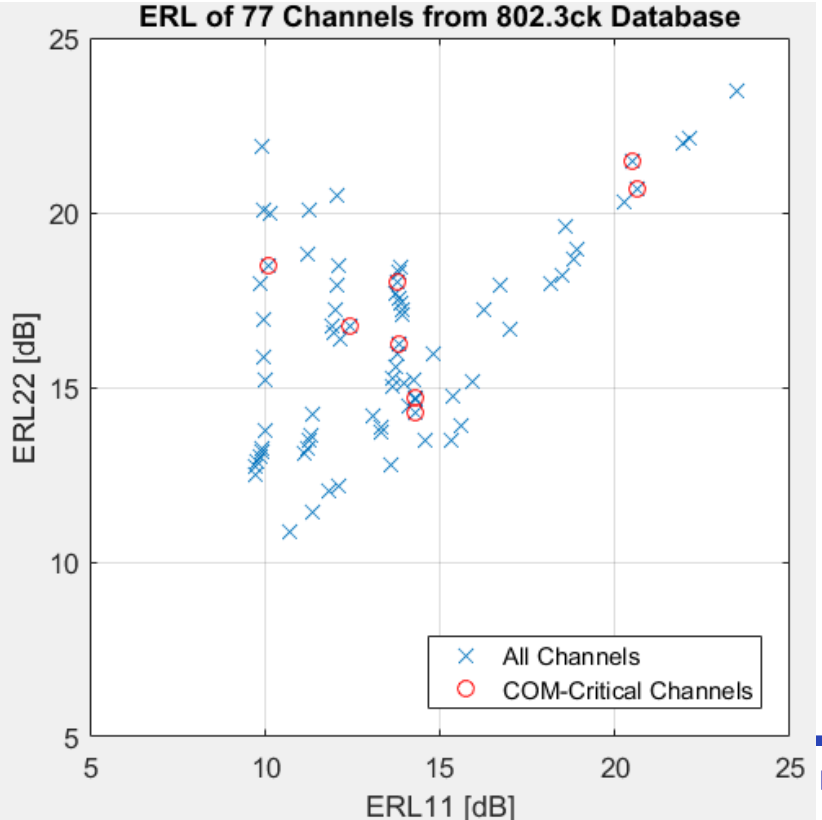
CH #	Description	Reference Document
1	Cable_BKP_28dB\Cable_BKP_28dB_0p575m	heck_3ck_01_1118.pdf
2	Cable_BKP_16dB\Cable_BKP_16dB_0p575m_more_isi	heck_3ck_01_1118.pdf
3	CaBP_BGAVia_Opt2_28dB\CaBP_BGAVia_Opt2_28dB	mellitz_3ck_adhoc_02_081518.pdf
4	tracy_3ck_03_0119_tradBP\Std_BP_12inch_Meg7	Tracy_3ck_01_0119
5	tracy_3ck_02_0119_orthoBP\DPO_IL_12dB	Tracy_3ck_01_0119
6	kareti_3ck_01_1118_ortho\OAch4 (updated)	kareti_3ck_01a_1118.pdf
7	kareti_3ck_01_1118_cabledBP\CAch3_b2	kareti_3ck_01a_1118.pdf
8	kareti_3ck_01_1118_backplane_2\Bch2_b7p5_7	kareti_3ck_01a_1118.pdf
9-22	16/20/24/28dB Cabled Backplane Channels	heck_3ck_01_1118.pdf
23-27	24/28/32dB Cabled Backplane Channels including Via	mellitz_3ck_adhoc_02_081518.pdf
28-45	Measured Traditional Backplane Channels	kareti_3ck_01a_1118.pdf
46-63	Measured Cabled Backplane Channels	
64-77	Measured Orthogonal Backplane Channels	

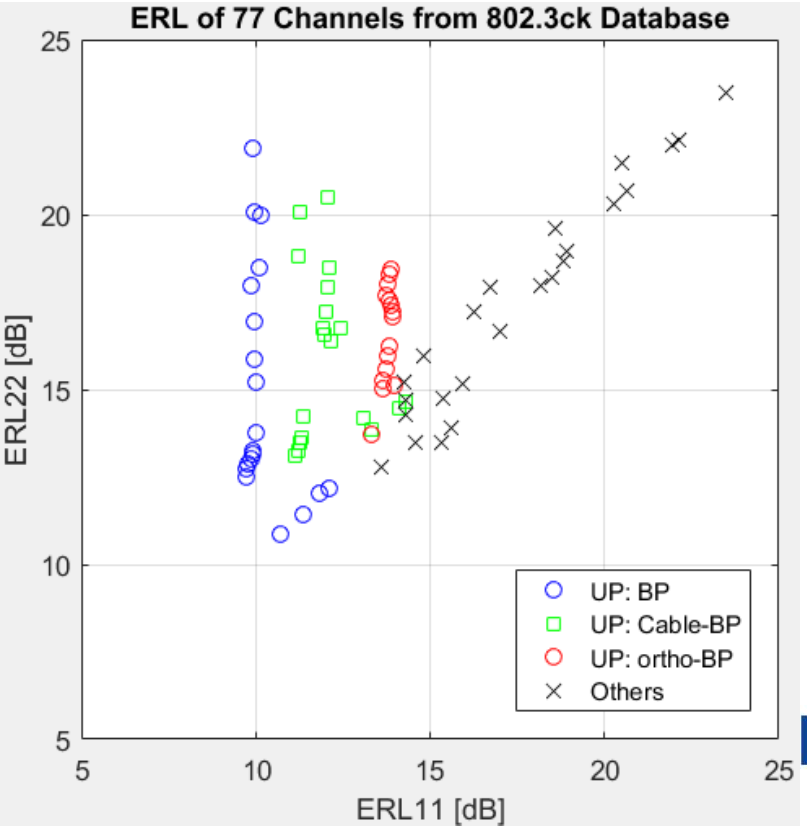
Critical Channels

All channel data are from IEEE 802.3ck Task Force Tools & Channels page: http://www.ieee802.org/3/ck/public/tools/index.html

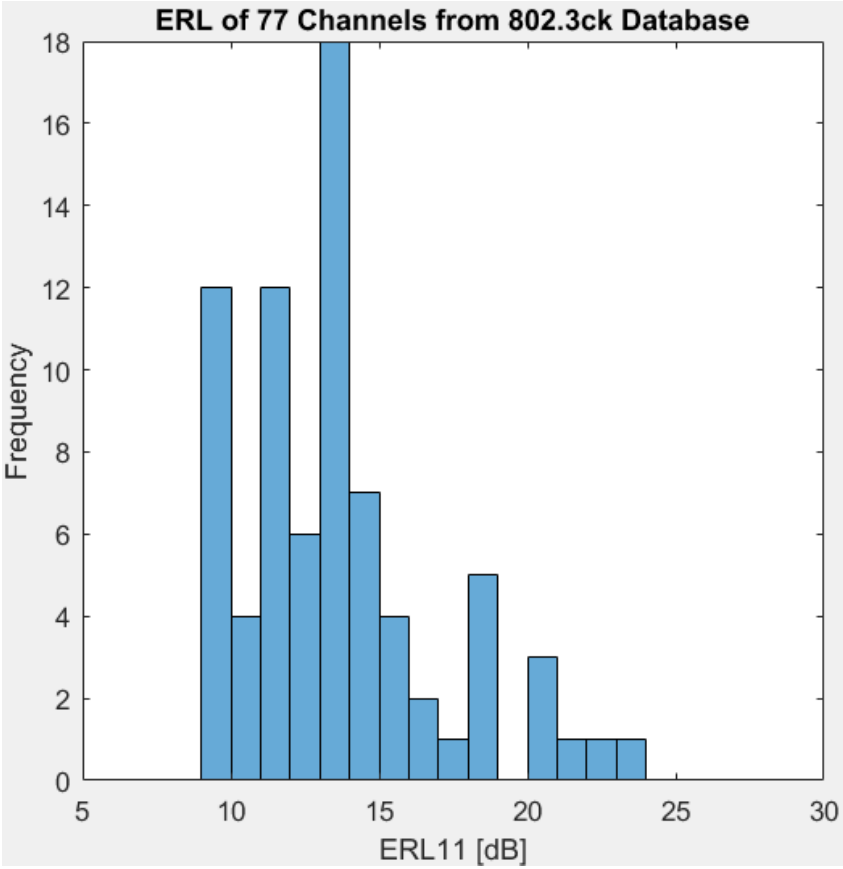
Reason for Channel ERL Spec: No Change (1/2)

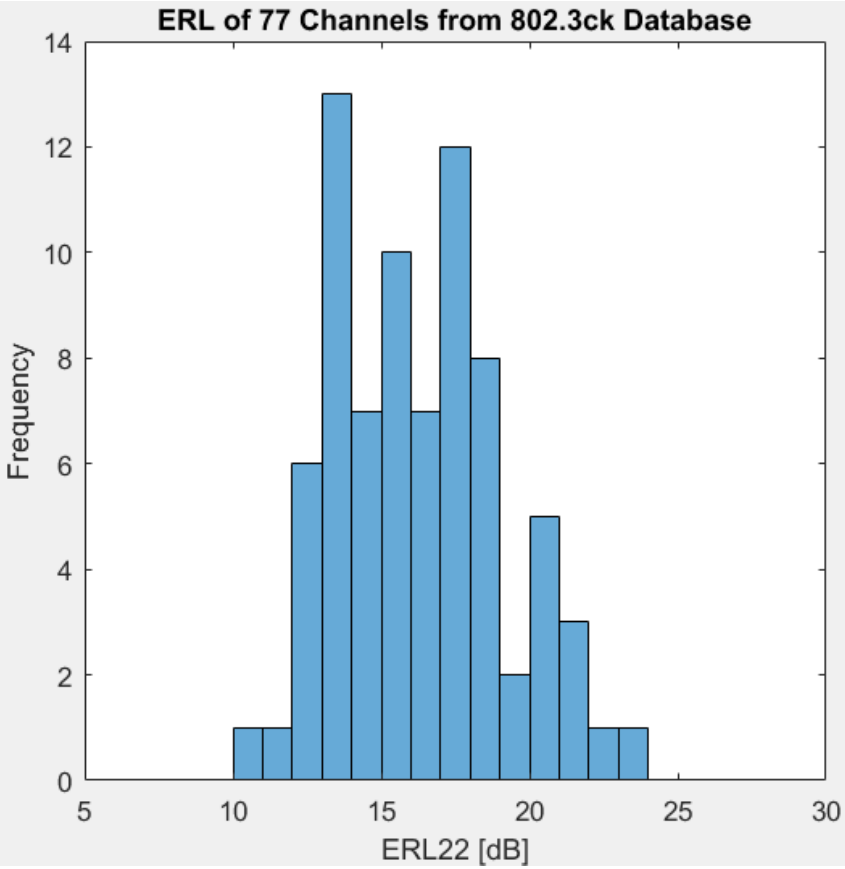
- Some channels are marginally failing for 10dB ERL proposal
  - Though floating taps may improve channel ERL, their use could deduce TX/RX ERL
    - Same taps setting must be used for TX/RX and channel
  - Particular group of the channels fail: any room to slightly improve?





Reason for Channel ERL Spec: No Change (2/2)





Reason for No Change of Grr and Gloss Equations from 802.3cd

- While 802.3cd's equations may be arguable, some silicon data supported 802.3cd ERL methodology
  - No equation change until new equation(s) is(are) proposed which provides more solid foundation
  - ERL dB spec is rather relative than absolute since its physical meaning is not vey clear

802.3cd ERL Silicon Correlation
http://www.ieee802.org/3/cd/public/May18/sakai_3cd_01_0518.pdf

Proposal: TX and RX ERL

- TX ERL at test point T shall be greater than or equal to 15dB
- RX ERL at test point R shall be greater than or equal to 15dB

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

0.010 ns

200

Proposal: Channel ERL

- Channel ERL at test point T and at test point R shall be greater than or equal to 10dB

0.010 ns

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

2000

References

[1] http://www.ieee802.org/3/ck/public/adhoc/jun12_19/healey_3ck_adhoc_01_061219.pdf

Thank You