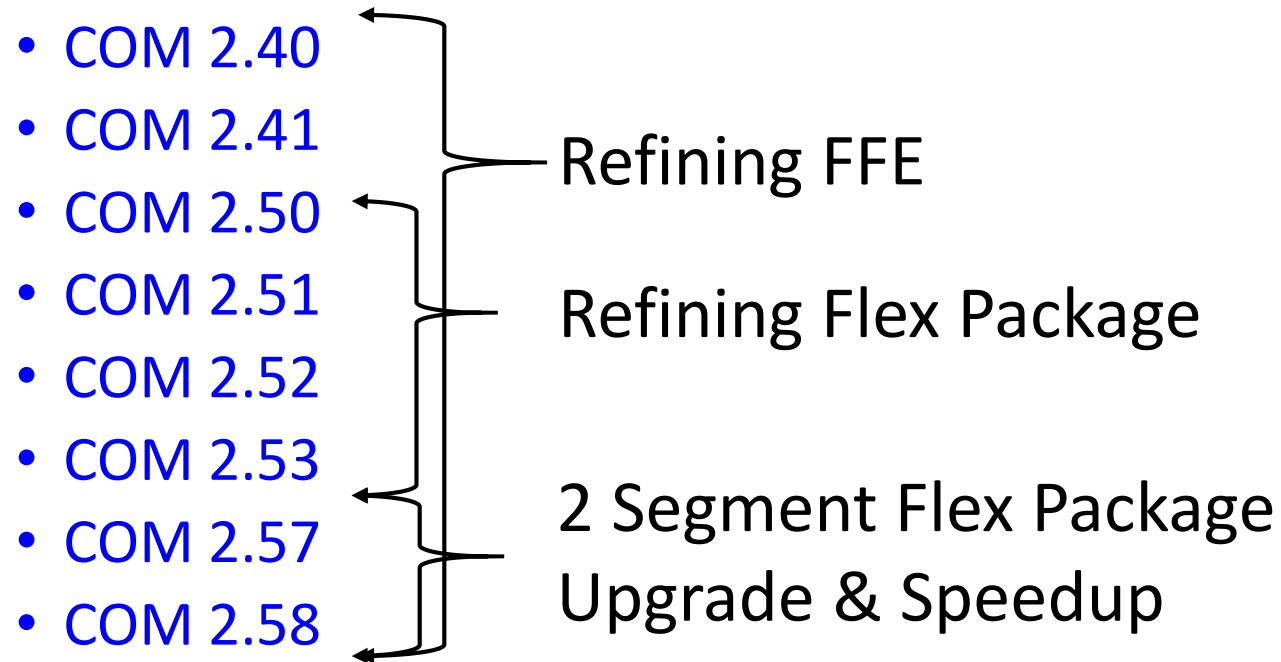# ERL Feature Additions Required for C2M in COM 2.60

Richard Mellitz, Samtec

March 2019, Vancouver

Table of Contents

❑ COM 2.60 – COM updates for ERL for C2M

❑ COM evolution backup– not to be presented

- COM 2.40
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- COM 2.50
- COM 2.51   Refining Flex Package
- COM 2.52
- COM 2.53
- COM 2.57   2 Segment Flex Package
- COM 2.58   Upgrade & Speedup

All version are backward compatible with .3bj, .3bm, .3bs, .3by, .3cd

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COM 2.60 features added for C2M

❑ New configuration xls file switches, N_bx & TDR_W_TXPKG

❑ N_bx (0/1) is used for ERL rather than N_b (number of dfe taps)

- Earlier versions defaulted to N_b
- If rxFFE is used instead of a DFE this provides capability to define the ERL gating region with a separate parameter N_bx and not N_b which may be 0

❑ TDR_W_TXPKG (0/1) switch allows TDR and ERL to be reported with the Tx package added
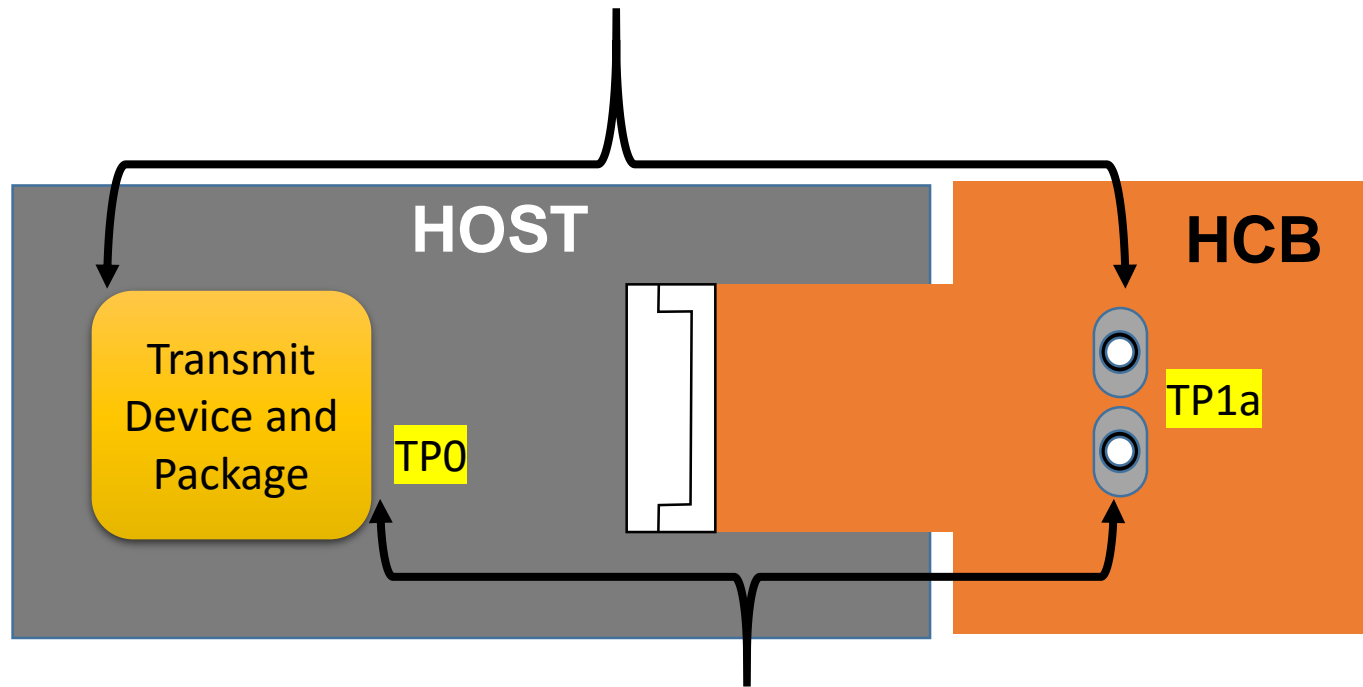
❑ Fixture delay time for each port supported

- example

fixture delay time	[0 1.13e9]

TDR_W_TXPKG = 1

Emulates measured C2M Host with HCB

Report:
- ERL11 is measured at TP0
- ERL22 is measured at TP1a
- ERL report is the minimum of ERL11 and ERL22
- Pmax/Vf estimate is at TP1a. (needs to be refined once the reference equalizer is better defined

HOST

Transmit Device and Package

TP0

HCB

TP1a

Channels used for C2M evaluation of an informative COM
Earlier COM reported ERL only for this channel (TP0 and TP1a w/o Tx)

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COM 2.60 clean up

❑ Re-align output to terminal reporting COM_db and IL last

❑ Fixed problem with the display pass/fail window message

❑ Changed legend in IL graphs to "IL with package and risetime"

❑ Fix reporting problem if Min_VEO is set in spreadsheet

❑ Upgraded optimize_FOM to include NEXT when rxFFE is used

COM 2.60 Experimental

❑ Experiment: USE_ETA0_PSD (0/1) switch introduced to include $H_{sy}(F)$ in sigma_n

❑ Parameter for ETA0 PSD hard coded

- f_{spike} = 1 GHz

Thank You!

backup

COM 2.40

IEEE P802.3ck July 25, 2018 Ad Hoc Meeting

http://www.ieee802.org/3/ck/public/adhoc/july25_18/mellitz_3ck_adhoc_01a_072518.pdf

Available for analysis

1. Zero Forced DFE
2. Quantized Forced DFE - abandoned
   - only produced COM offset
3. One DFE tap and a number of (Rx)FFE taps
   - Sum of taps = 1
4. One DFE tap and a number of (Rx)FFE taps with gain at cursor - abandoned
   - Same as 4 but gain at cursor
   - Gain not justified

Changed computation of crosstalk variance in optimize_FOM()/get_xtlk_noise() to be computed similar to ICN in the frequency domain.

❑ 5x speed-up for 7 or more crosstalk aggressor
❑ Original get_xtlk_noise() renamed to get_xtlk_noise1()

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COM 2.41

IEEE P802.3ck August 15, 2018 Ad Hoc Meeting

http://www.ieee802.org/3/ck/public/adhoc/aug15_18/mellitz_3ck_adhoc_01_081518.pdf

1. Zero Forced DFE

2. Quantized Forced DFE - abandoned

3. One DFE tap and a number of (Rx)FFE taps
   - Cursor tap set to 1

4. One DFE tap and a number of (Rx)FFE taps with gain at cursor - abandoned

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COM 2.50

❏ Flexible Package Model added
  • http://www.ieee802.org/3/ck/public/18_09/mellitz_3ck_01_0918.pdf

Table 93A–3 parameters		
Parameter	Setting	Units
package_tl_gamma0_a1_a2	[0 1.0404e-3 4.201e-4]	
package_tl_tau	6.325E-03	ns/mm
package_Z_c	[87.5 87.5 ; 110 110; 87.5 87.5; 87.5 87.5]	Ohm (Tx Rx)

C_d	[1.1e-4 1.1e-4]
z_p select	1
z_p (TX)	[15.5 20 30; 1.8 0 0; 7.5 0 0; 7 0 0]
z_p (NEXT)	[15.5 20 30; 1.8 0 0; 7.5 0 0; 7 0 0]
z_p (FEXT)	[15.5 20 30; 1.8 0 0; 7.5 0 0; 7 0 0]
z_p (RX)	[15.5 20 30; 1.8 0 0; 7.5 0 0; 7 0 0]
C_p	[0.7e-4 0.7e-4]
C_v	[5e-6 5e-6]

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COM 2.51

IEEE P802.3ck OCT 03, 2018 Ad Hoc Meeting

http://www.ieee802.org/3/ck/public/adhoc/oct03_18/mellitz_3ck_adhoc_01_100318.pdf

❑ Rx FFE monotonic tap sensitivity refinement per wu_3ck_01_0918 in the IEEE P802.3ck July interim meeting

http://www.ieee802.org/3/ck/public/18_09/wu_3ck_01_0918.pdf
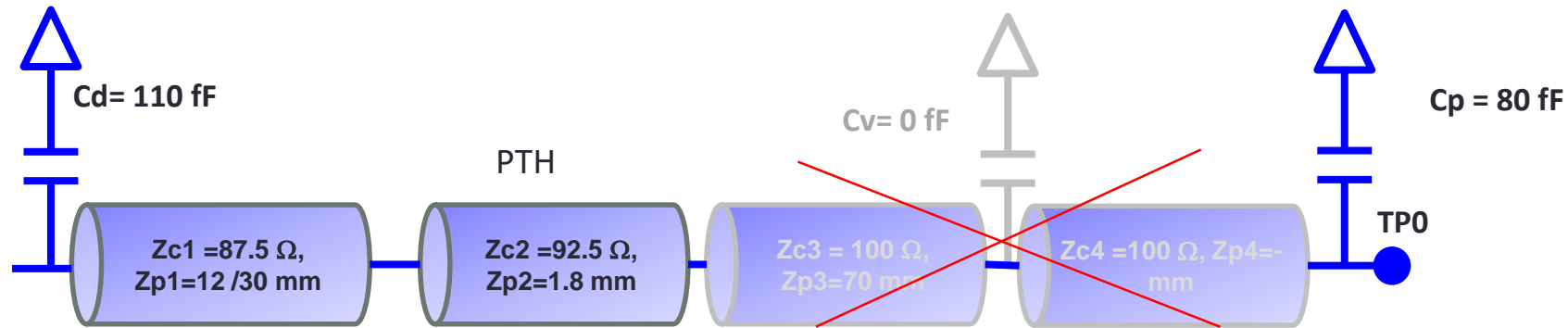
❑ Fixed RxFFE index modulus problem in force()

- John Ewen, Global Foundries

❑ Refined RxFFE post cursor forcing to the minimum of the post cursor pulse response value or the DFE1 b_{max} limit.

❑ Removed minimum signal threshold for TDR and ERL computations

COM 2.52 12 mm & 30 mm package

❑ Flexible Package Model initial 12 mm / 30 mm suggestion

❑ From Liav Ben-Artsi, Marvell Israel Ltd

Parameter	Setting	Units
package_tl_gamma0_a1_a2	[0 0.0007901838 0.00050925]	
package_tl_tau	6.325E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5; 100 100 ; 100 100]	Ohm

C_d	[1.1e-4 1.1e-4]
z_p select	[1 2]
z_p (TX)	[12 30; 1.8 1.8 ; 0 0 ; 0 0]
z_p (NEXT)	[12 30; 1.8 1.8 ; 0 0 ; 0 0]
z_p (FEXT)	[12 30; 1.8 1.8 ; 0 0 ; 0 0]
z_p (RX)	[12 30; 1.8 1.8 ; 0 0 ; 0 0]
C_p	[0.8e-4 0.8e-4]
C_v	[0 0]

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COM 2.52 (test version only)

❑ add Rx FFE filter to receiver noise filter to eq. 93A-35 per request from Bill Kirkland, Semtech

  • This basically adds Rx noise amplification from the Rx FFE

$$\sigma_N^2 = \eta_0 \int_0^\infty \left| H_r(f) H_{ctf}(f) \right|^2 df$$

$H_{RxFFE}(f)$

❑ change ICN in get_xtlk_noise() to end at fb rather than fb/2. No impact observed because only used to compute the FOM to determine equalizer settings
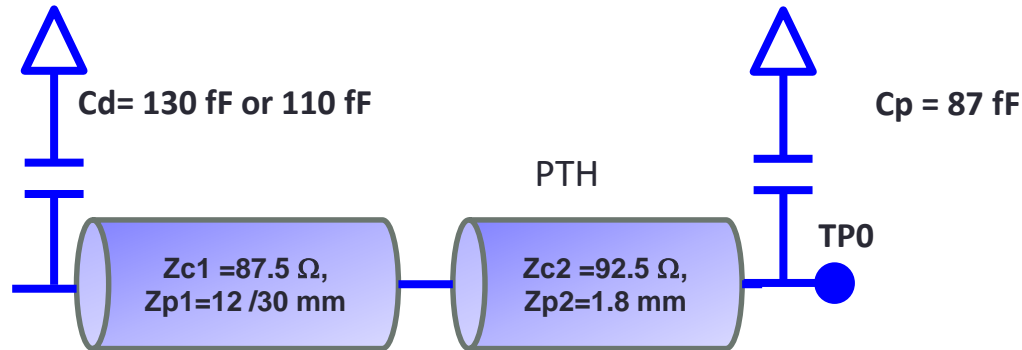
❑ 12 mm and 30 mm package proposal spreadsheets

COM 2.53 just bug fixes

❑ Equivalent to 2.52 with a minor bug fix

❑ Keep some channels from crashing COM

- Indexing fix in force routine
- Upen Kateri

❑ Remove bug when not FFE post cursors are present but FFE precursors are requested

- Yasuo Hidaka

COM 2.57 12 mm & 30 mm package

❑ Reduce Syntax for Flex model (2 section)

❑ Latest package model fits

Cd= 130 fF or 110 fF

Cp = 87 fF

PTH

TP0

Zc1 =87.5 Ω, Zp1=12 /30 mm

Zc2 =92.5 Ω, Zp2=1.8 mm

C_d	[1.1e-4 1.1e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[12 30; 1.8 1.8]	mm	[test cases]
z_p (NEXT)	[12 30; 1.8 1.8]	mm	[test cases]
z_p (FEXT)	[12 30; 1.8 1.8]	mm	[test cases]
z_p (RX)	[12 30; 1.8 1.8]	mm	[test cases]
C_p	[0.87e-4 0.87e-4]	nF	[TX RX]

Table 93A–3 parameters		
Parameter	**Setting**	**Units**
package_tl_gamma0_a1_a2	[0 0.0009909 0.0002772]	
package_tl_tau	6.1400E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm

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COM 2.57 updates

❏ optimize_fom function
  - Fix testing of maximum precursor value (Yasuo Hidaka)
    - Do not allow excessively large precursor taps

❏ Accept syntax for 2 segment line flex package model
  - This syntax will not working on older versions

❏ 3 starter configuration sheets
  - config_com_ieee8023_93a=100GEL-KR_DFE_121918.xls
  - config_com_ieee8023_93a=100GEL-CR_DFE_121918.xls
  - config_100GEL_C2M_4dBpkg_baseline_121918.xls
  - config_100GEL_C2M_4dBpkg_baseline_tp1a_121918.xls

❏ speed up in optimize FOM

❏ added code from Yasuo Hidaka for reading in parameters and printing out noise

❏ Improved extrapolation of channel with lower bandwidths in s21_to_impulse_DC from John Ewen

❏ In get_xtlk_noise in optimize_FOM: refine crosstalk accounting from John Ewen

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COM 2.58

❑ Correction to support different Tx and Rx packages with flex packages

❑ Prior flex versions used the same Cp for Tx and Rx.

❑ Added two requested keyword option for the configuration spread sheet.

- *Keyword* EXE_MODE
    - 0 *full grid search as all version prior to 2.53*
    - 1 *ignored optimization search for just one setting*
    - *2 ignored all following setting for c(1)*
      all other setting are searched
- *Keyword:* CDR
    - MM *as in Annex 93A (default if not specified)*
    - mod-MM *as in lu_3ck_adhoc_01_121218*

```
switch OP.EXE_MODE
    case 0
    case 1
        if (20*log10(A_s/sigma_ISI) < best_FOM)
            continue
        end
    case 2
        if (20*log10(A_s/sigma_ISI) < best_FOM)
            break
        end
end
```

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