COM 2.75 Update

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IEEE 802.3 100 Gb/s, 200 Gb/s, and 400 Gb/s Electrical Interfaces Task Force Ad Hoc

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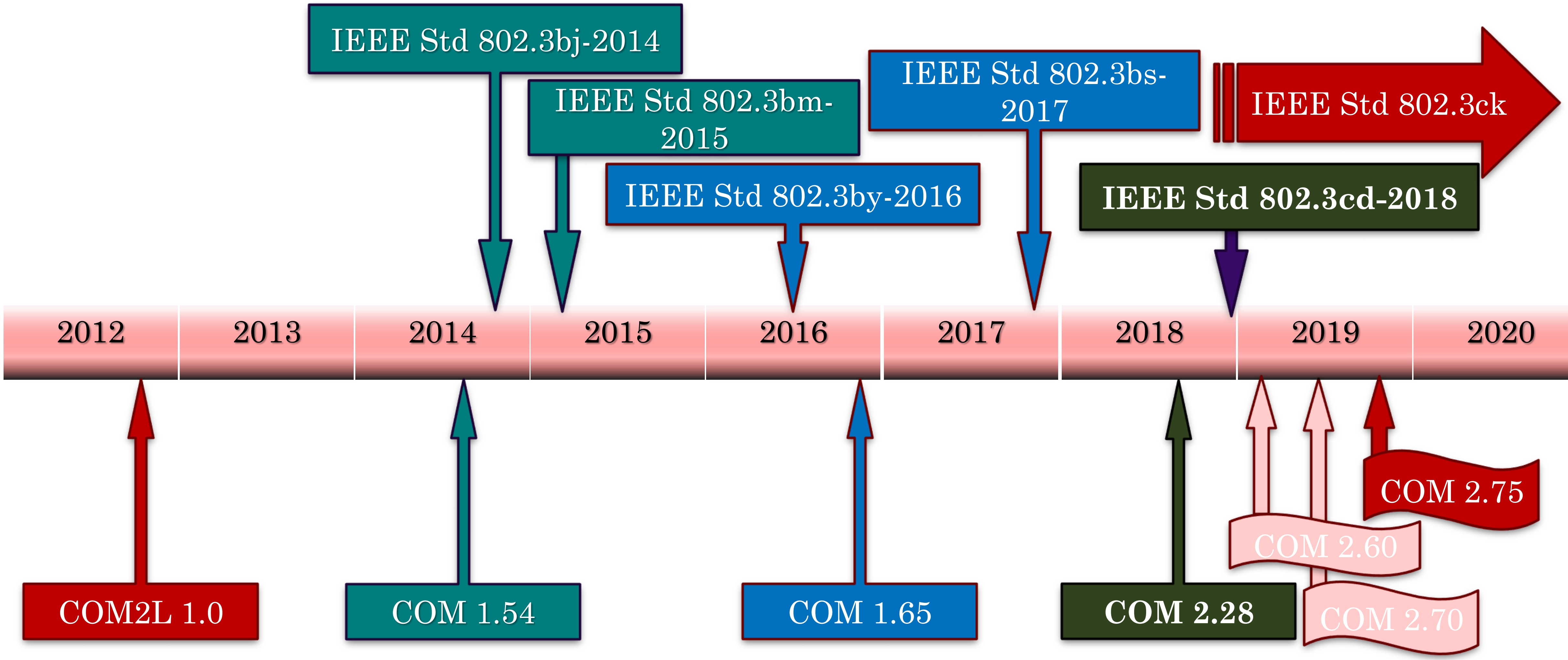
COM Timeline



COM 2.75 highlights

- For ERL computation:
  - Corrected delay TDR and ERL adjustment for Gaussian edge
  - No syntax change
  - May increase ERL by a few tens of dB
- For CR, added board added C_0 and C_1 syntax
  - http://www.ieee802.org/3/ck/public/19_09/benartsi_3ck_01a_0919.pdf
- Miscellaneous: These do not affect the COM computations
  - fixed version syntax problem
    - In output_args RL report
  - fixed eye width computation
    - problem: crosstalk for eye width was not included in previous versions
  - removed eye width report if doing a Rx calibration
  - Added syntax for ICN calculation
    - f_f, f_n, f_2, A_ft, A_nt
    - Use to use Av…etc. and other COM computation parameters
  - fixed PSXTK graph

In COM function get_TDR TDR, Transmitter edge delay is compensated. This which was introduced in the Gaussian edge filter

- For ERL computation: Transition time filter in COM added 3 times the Gaussian edge rate

```
% add delay 500 ps for TDR and 3 times Gaussian transition time
% (makes Gaussian edge somewhat causal)
H_t = exp( -2*(pi*f9*(tr)/1.6832).^2 ).*exp(-(1j)*2*pi*f9*TDR_results.delay/1e-9).*exp(-1j*2*pi*f9*tr*3);
```

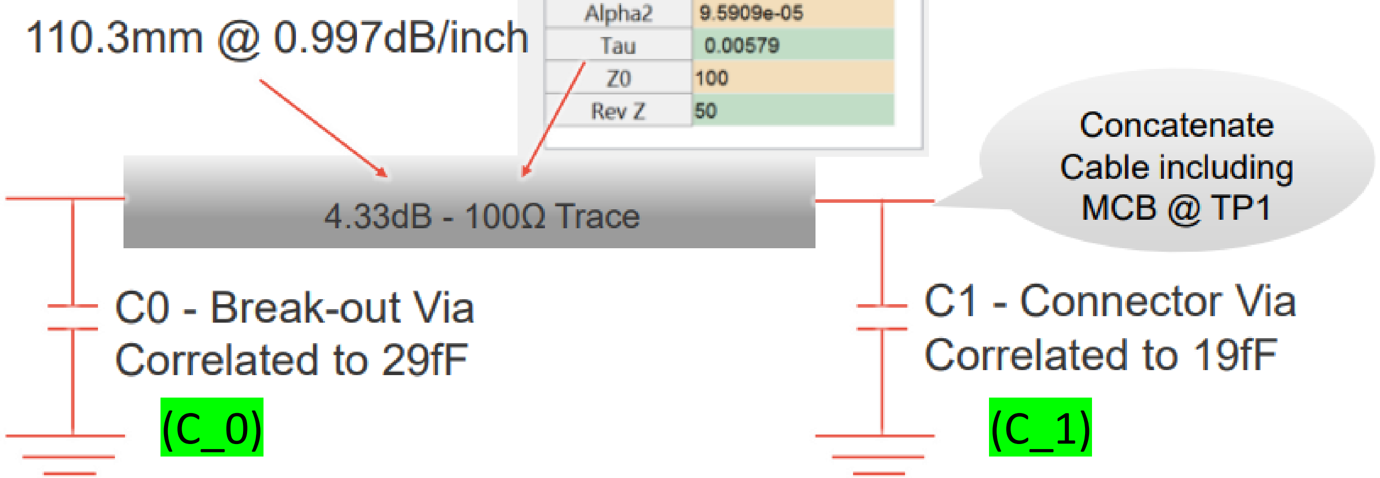
- Code introduced in V2.75 accommodates for this delay in gating functions G_{rr} and G_{loss} in ERL (eq 93A-61 and 93A-62)
  - Acknowledgement to Adam Healey

For CR, added board added C_0 and C_1 syntax

Model to be Inserted as “Include PCB” - Reminder

http://www.ieee802.org/3/ck/public/19_09/benartsi_3ck_01a_0919.pdf

Gamma 0	0
Alpha 1	3.8206e-04
Alpha2	9.5909e-05
Tau	0.00579
Z0	100
Rev Z	50



Better ICN reporting control

COM keyword	ICN CL 83 parameter
f_f	f_{ft}
f_n	f_{nt}
f_2	Range f_n
A_ft	A_{ft}
A_nt	A_{nt}

85.10.7 Cable assembly integrated crosstalk noise (ICN)

In order to limit multiple disturber crosstalk noise at a receiver, the cable assembly integrated crosstalk noise (ICN) is specified in relationship to the measured insertion loss. ICN is calculated from the MDFEXT and MDNEXT. Given the multiple disturber near-end crosstalk loss *MDNEXT_loss*(f) and multiple disturber far-end crosstalk loss *MDFEXT_loss*(f) measured over N uniformly-spaced frequencies f_n spanning the frequency range 50 MHz to 10000 MHz with a maximum frequency spacing of 10 MHz, the RMS value of the integrated crosstalk noise shall be determined using Equation (85–28) through Equation (85–32). The RMS crosstalk noise is characterized at the output of a specified receive filter utilizing a specified transmitter waveform and the measured multiple disturber crosstalk transfer functions. The transmitter and receiver filters are defined in Equation (85–28) and Equation (85–29) as weighting functions to the multiple disturber crosstalk in Equation (85–30) and Equation (85–31). The sinc function is defined by $\mathrm{sinc}(x) = \sin(\pi x)/(\pi x)$.

Define the weight at each frequency f_n using Equation (85–28) and Equation (85–29).

$$W_{nt}(f_n) = (A_{nt}^2/f_b)\,\mathrm{sinc}(f_n/f_b)^2\left[\frac{1}{1+(f_n/f_{nt})^4}\right]\left[\frac{1}{1+(f_n/f_r)^8}\right] \quad (85\text{–}28)$$

$$W_{ft}(f_n) = (A_{ft}^2/f_b)\,\mathrm{sinc}(f_n/f_b)^2\left[\frac{1}{1+(f_n/f_{ft})^4}\right]\left[\frac{1}{1+(f_n/f_r)^8}\right] \quad (85\text{–}29)$$

where the equation parameters are given in Table 85–11.

Note that the 3 dB transmit filter bandwidths f_{nt} and f_{ft} are inversely proportional to the 20% to 80% rise and fall times T_{nt} and T_{ft} respectively. The constant of proportionality is 0.2365 (e.g., $T_{nt}f_{nt} = 0.2365$; with f_{nt} in hertz and T_{nt} in seconds). In addition, f_r is the 3 dB reference receiver bandwidth, which is set to 7.5 GHz.

COM 2.70 highlights

- Floating DFE taps
  - http://www.ieee802.org/3/ck/public/19_05/kareti_3ck_01b_0519.pdf
  - http://www.ieee802.org/3/ck/public/19_05/heck_3ck_01_0519.pdf
  - http://www.ieee802.org/3/ck/public/19_05/mellitz_3ck_01c_0519.pdf
- Coil Circuit Improving C_d Termination – Adam Healey
- Informative Eye Width Reported for C2M

KR Configuration Spreadsheet Instance So Far

Table 93A-1 parameters			
Parameter	Setting	Units	Information
f_b	53.125	GBd	
f_min	0.05	GHz	
Delta_f	0.01	GHz	
C_d	[1.2e-4 1.2e-4]	nF	[TX RX]
L_s	[0.12, 0.12]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (NEXT)	[12 29; 1.8 1.8]	mm	[test cases]
z_p (FEXT)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (RX)	[12 29; 1.8 1.8]	mm	[test cases]
C_p	[0.87e-4 0.87e-4]	nF	[TX RX]
R_0	50	Ohm	
R_d	[50 50]	Ohm	[TX RX]
A_v	0.415	V	
A_fe	0.415	V	
A_ne	0.608	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.54		min
c(-1)	[-0.34:0.02:0]		[min:step:max]
c(-2)	[0:0.02:0.12]		[min:step:max]
c(-3)	[-0.06:0.02: 0]		[min:step:max]
c(1)	[-0.2:0.05:0]		[min:step:max]
N_b	12	UI	
b_max(1)	0.85		
b_max(2..N_b)	0.2		
g_DC	[-20:1:0]	dB	[min:step:max]
f_z	21.25	GHz	
f_p1	21.25	GHz	
f_p2	53.125	GHz	
g_DC_HP	[-6:1:0]		[min:step:max]
f_HP_PZ	0.6640625	GHz	

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_KR_{date}\	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	KR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	10.5	dB
DER_0	1.00E-04	
T_r	6.16E-03	ns
FORCE_TR	1	logical

TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3000	
beta_x	2.3407E+09	
rho_x	0.19	
fixture delay time	[0 0]	[port1 port2]
TDR_W_TXPKG	0	
N_bx	12	UI
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
Noise, jitter		
sigma_RJ	0.01	UI
A_DD	0.02	UI
eta_0	8.2E-09	V^2/GHz
SNR_TX	33	dB
R_LM	0.95	

Table 93A–3 parameters		
Parameter	Setting	Units
package_tl_gamma0_a1_a2	[0 0.0009909 0.0002772]	
package_tl_tau	6.141E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm
benartsi_3ck_01_0119 & mellitz_3ck_01_0119		
Table 92–12 parameters		
Parameter	Setting	
board_tl_gamma0_a1_a2	*[0 3.8206e-04 9.5909e-05]*	
board_tl_tau	*5.790E-03*	ns/mm
board_Z_c	100	Ohm
z_bp (TX)	*110.3*	mm
z_bp (NEXT)	*110.3*	mm
z_bp (FEXT)	*110.3*	mm
z_bp (RX)	*110.3*	mm
C_0	[0.29e-4]	nF
C_1	[0.19e-4]	nF
Include PCB	**0**	**logical**

Floating Tap Control		
N_bg	3	0 1 2 or 3 groups
N_bf	3	taps per group
N_f	40	UI span for floating taps
bmaxg	0.2	max DFE value for floating taps

cable assemblies require this for each HCB

ICN parameters (v2.73)		
f_f	12.919	
f_n	12.919	
f_2	39.844	
A_ft	0.600	
A_nt	**0.600**	

heck_3ck_03b_0319	**Adopted Mar 2019**
walker_3ck_01d_0719	**Adopted July 2019**
result of R_d=50	
benartsi_3ck_01a_0719	**no used for KR**
mellitz_3ck_03_0919	
under consideration	

Package Proposal with LC Termination Compensation (single sided model)

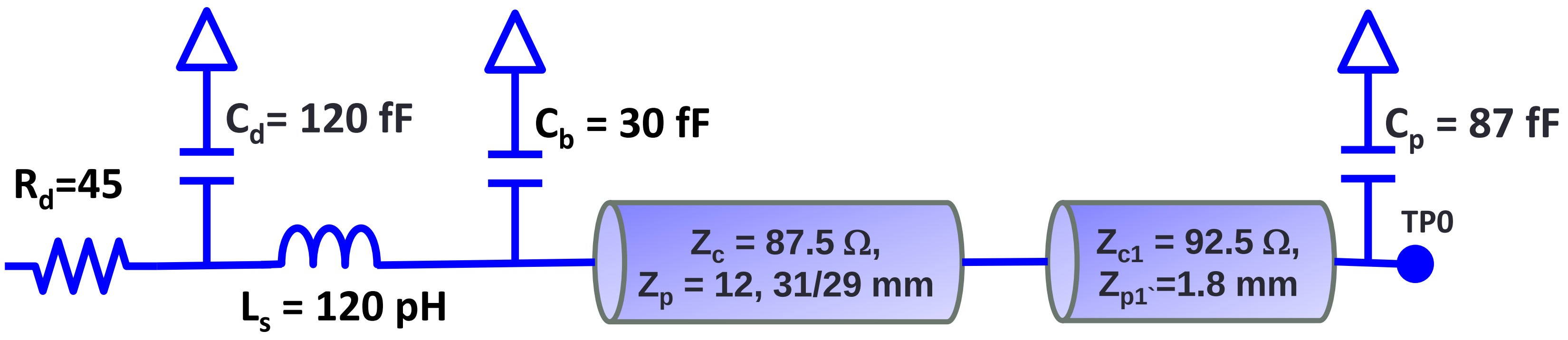
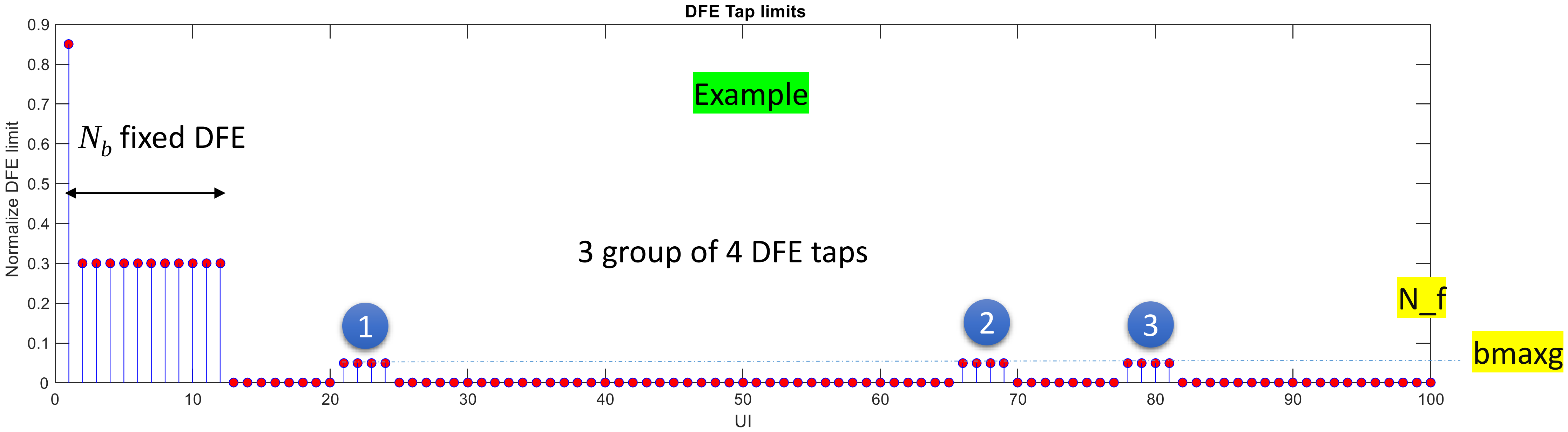


Table 93A-1 parameters			
Parameter	**Setting**	**Units**	**Information**
C_d	[1.2e-4 1.2e-4]	nF	[TX RX]
L_s	[0.12, 0.12]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (NEXT)	[12 29; 1.8 1.8]	mm	[test cases]
z_p (FEXT)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (RX)	[12 2990; 1.8 1.8]	mm	[test cases]
C_p	[0.87e-4 0.87e-4]	nF	[TX RX]
R_0	50	Ohm	
R_d	[45 45]	Ohm	[TX RX]
A_v	0.39	V	vp/vf=.694
A_fe	0.39	V	vp/vf=.694
A_ne	0.578	V	

Table 93A–3 parameters		
Parameter	**Setting**	**Units**
package_tl_gamma0_a1_a2	[0 0.0009909 0.0002772]	
package_tl_tau	6.141E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm

Parameters for Floating DFE Taps and Example
Values Maybe Further Refined

Floating Tap Control		
N_bg	3	0 1 2 or 3 groups
N_bf	*4*	taps per group
N_f	100	UI span for floating taps
bmaxg	0.1	max DFE value for floating taps



Thank You!

Backup data

COM 2.60 and Earlier Highlights

- Include package in ERL computation for C2M COM
- Simplify 4 element to 2 element transmission line package model
- Max DER at COM limit now reported
- Computation speed up
- Rx FFE (vector forced) for C2M
  - http://www.ieee802.org/3/ck/public/18_07/mellitz_3ck_01_0718.pdf Slide 7
  - http://www.ieee802.org/3/ck/public/adhoc/oct03_18/mellitz_3ck_adhoc_01_100318.pdf Slide 10

CA Configuration Spreadsheet Instance So Far

Table 93A-1 parameters			
Parameter	**Setting**	**Units**	**Information**
f_b	53.125	GBd	
f_min	0.05	GHz	
Delta_f	0.01	GHz	
C_d	[1.2e-4 1.2e-4]	nF	[TX RX]
L_s	[0.12, 0.12]	nH	[TX RX]
C_b	[0.3e-4 0.3e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (NEXT)	[12 29; 1.8 1.8]	mm	[test cases]
z_p (FEXT)	[12 31; 1.8 1.8]	mm	[test cases]
z_p (RX)	[12 29; 1.8 1.8]	mm	[test cases]
C_p	[0.87e-4 0.87e-4]	nF	[TX RX]
R_0	50	Ohm	
R_d	[50 50]	Ohm	[TX RX]
A_v	0.415	V	vp/vf=.694
A_fe	0.415	V	vp/vf=.694
A_ne	0.608	V	
L	4		
M	32		
filter and Eq			
f_r	0.75	*fb	
c(0)	0.54		min
c(-1)	[-0.34:0.02:0]		[min:step:max]
c(-2)	[0:0.02:0.12]		[min:step:max]
c(-3)	[-0.06:0.02: 0]		[min:step:max]
c(1)	[-0.2:0.05:0]		[min:step:max]
N_b	12	UI	
b_max(1)	0.85		
b_max(2..N_b)	0.2		
g_DC	[-20:1:0]	dB	[min:step:max]
f_z	21.25	GHz	
f_p1	21.25	GHz	
f_p2	53.125	GHz	
g_DC_HP	[-6:1:0]		[min:step:max]
f_HP_PZ	0.6640625	GHz	

I/O control		
DIAGNOSTICS	1	logical
DISPLAY_WINDOW	1	logical
CSV_REPORT	1	logical
RESULT_DIR	.\results\100GEL_CR_{date}\	
SAVE_FIGURES	0	logical
Port Order	[1 3 2 4]	
RUNTAG	CR_eval_	
COM_CONTRIBUTION	0	logical
Operational		
COM Pass threshold	3	dB
ERL Pass threshold	10	dB
DER_0	1.00E-04	
T_r	6.16E-03	ns
FORCE_TR	1	logical

TDR and ERL options		
TDR	1	logical
ERL	1	logical
ERL_ONLY	0	logical
TR_TDR	0.01	ns
N	3000	
beta_x	2.3407E+09	
rho_x	0.21	
fixture delay time	[0 0]	[port1 port2]
TDR_W_TXPKG	0	
N_bx	12	UI
Receiver testing		
RX_CALIBRATION	0	logical
Sigma BBN step	5.00E-03	V
Noise, jitter		
sigma_RJ	0.01	UI
A_DD	0.02	UI
eta_0	8.37E-09	V^2/GHz
SNR_TX	32.5	dB
R_LM	0.95	
	under consideration	

Table 93A–3 parameters		
Parameter	**Setting**	**Units**
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package_Z_c	[87.5 87.5 ; 92.5 92.5]	Ohm
benartsi_3ck_01_0119 & mellitz_3ck_01_0119		
Table 92–12 parameters		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	*[0 3.8206e-04 9.5909e-05]*	1 dB / in
board_tl_tau	*5.790E-03*	ns/mm
board_Z_c	100	Ohm
z_bp (TX)	*110.3*	mm
z_bp (NEXT)	*110.3*	mm
z_bp (FEXT)	*110.3*	mm
z_bp (RX)	*110.3*	mm
C_0	[0.29e-4]	nF
C_1	[0.19e-4]	nF
Include PCB	**1**	**logical**

Floating Tap Control		
N_bg	3	0 1 2 or 3 groups
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A_ft	0.600	
A_nt	**0.600**	
heck_3ck_03b_0319	**Adopted Mar 2019**	
walker_3ck_01d_0719	**Adopted July 2019**	
result of R_d=50		
benartsi_3ck_01a_0719	**require COM 2.72 or later**	
mellitz_3ck_03_0919		
mellitz_3ck_02_0919		