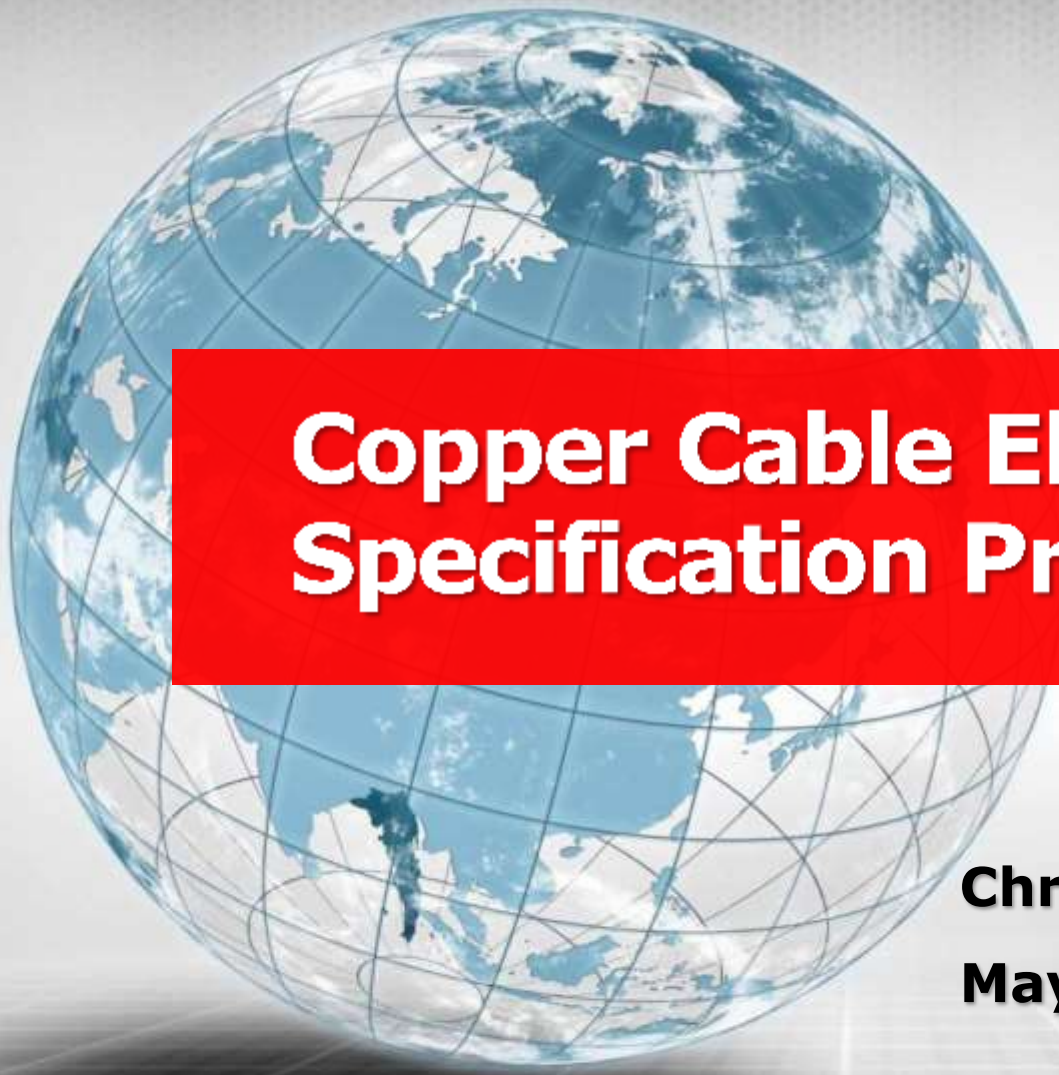

Copper Cable Electrical Specification Proposal

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Supporters

- Tom Palkert – Molex
- Scott Sommers – Molex
- Ali Ghiasi – Ghiasi Quantum
- Upen Kareti – Cisco
- Nathan Tracy – TE Connectivity

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Purpose

- **Baseline proposal for 802.3cd copper cable assembly consistent with adopted objectives**
  - Define a single-lane 50 Gb/s PHY for operation over copper twin-axial cables with lengths up to at least 3m
  - Define a two-lane 100 Gb/s PHY for operation over copper twin-axial cables with lengths up to at least 3m
  - Define a four-lane 200 Gb/s PHY for operation over copper twin-axial cables with lengths up to at least 3m
- **Provide data to make decisions once other TBDs are closed**

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S-parameter Adjustments

- **Reuse S-parameters per 802.3bj Clause 92.10**
- **Reduce loss allocated to the cable in 92.10.2**
  - Max Cable IL@ 13.28 GHz: 16.09dB
- **Reduce end to end loss budget in 92A.5**
  - Max Channel IL@ 13.28 GHz: 28.9dB
- **See roth_50GE_NGOATH_01a_0116.pdf for supporting cable data**
- **Aligned with diminico_3cd_01_0516.pdf**

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COM adjustments

- **Several examples of parameter adjustments have been presented**
  - ghiasi_030216_50GE_NGOATH_adhoc.pdf
  - kareti_50GE_NGOATH_02_0316.pdf
- **Points of relative consensus**
  - Improve the package
  - Adjust pre-cursor and post-cursor values for TX
  - Add gain to CTLE
  - Lengthen DFE to 15 or 16 taps
  - Improve TX SNR
- **Magnitudes are different but the approaches are similar**

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COM adjustments - Questions

- **How does the highest loss cable type perform with both proposals?**
  - 3m 26awg
- **Is there a happy medium?**
- **What DER will be required?**
  - Single largest impact on COM value
- **What COM value is required?**

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COM adjustments - Analysis

- **Use 6 different 3m 26awg QSFP cables to have a better sample size**
- **Run all cables using 3 COM configs**
  - Option 1: Based on kareti_50GE_NGOATH_02_0316.pdf
  - Option 2: Based on ghiasi_030216_50GE_NGOATH_adhoc.pdf
  - Option 3: Draws from both
- **Run at 3 different DER's**
  - 1e-4
  - 1e-5
  - 1e-6

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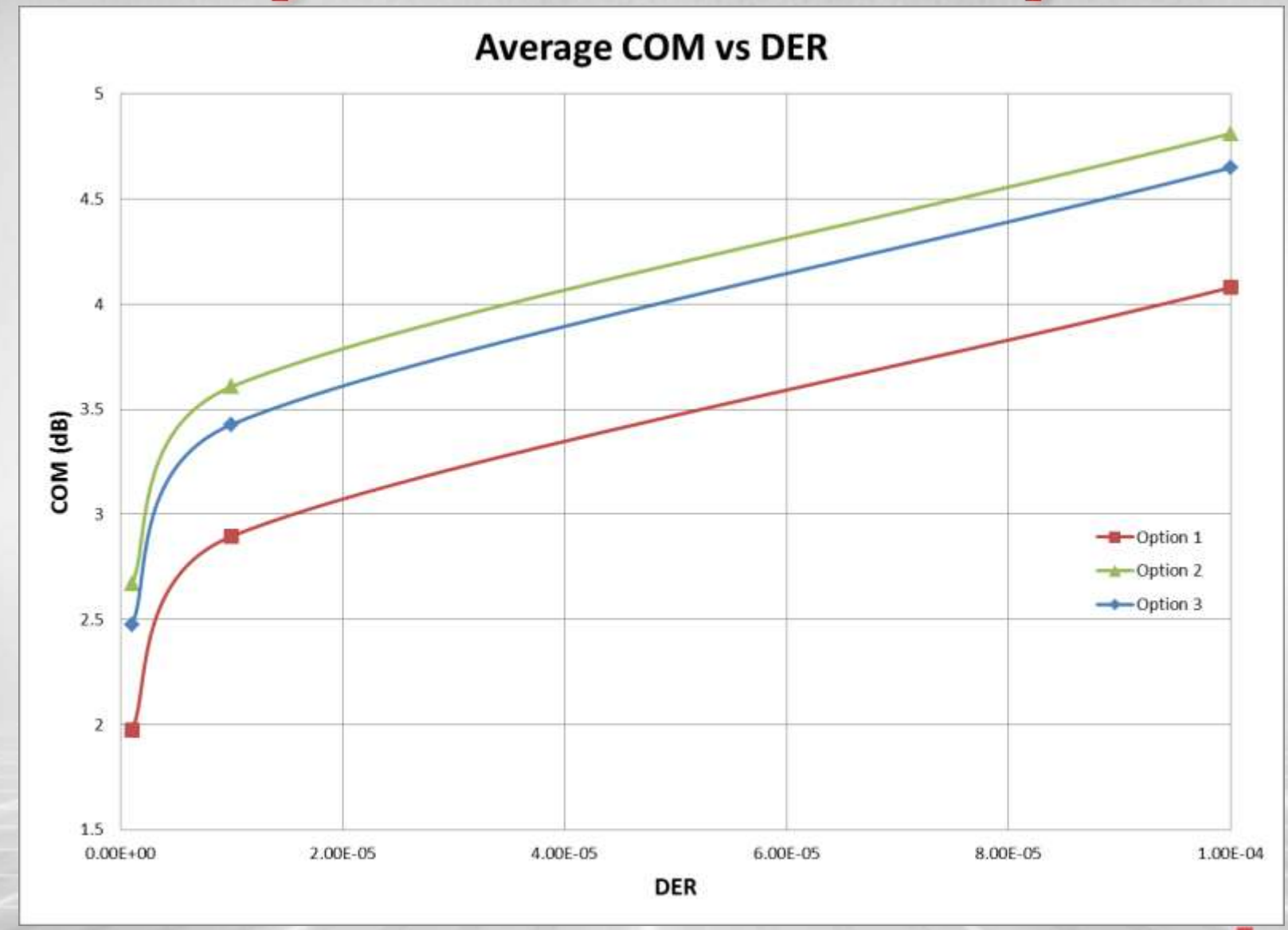
COM adjustment - Options

- **Option 1: Most conservative**
  - Moderate package improvement
  - Moderate increase in TX FFE complexity
  - Large increase in CTLE gain
  - Longer DFE with less powerful taps
- **Option 2: Most aggressive**
  - Large package improvement
  - Moderate increase in TX FFE complexity and power
  - Moderate increase in CTLE gain
  - Longer DFE with fairly powerful taps
  - Higher SNR_TX
- **Option 3: Compromise**
  - Large package improvement
  - Moderate increase in TX FFE complexity and power
  - Moderate increase in CTLE gain
  - Longer DFE with less powerful taps

COM adjustments - Analysis



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COM adjustments - Decisions

- **Now that we have data for COM vs DER we can answer the question of what values should be used in the spec and develop a few options**

COM Limits for Commercially Acceptable Yield @ a DER			
DER	Option 1 Limit	Option 2 Limit	Option 3 Limit
1.00E-04	3	3	3
1.00E-05	2.2	2.9	2.55
1.00E-06	1.3	2	1.6

Parameter	Option 1	Option 2	Option 3	Units
f_b	26.5625	26.5625	26.5625	GBd
f_min	0.05	0.05	0.05	GHz
Delta_f	0.01	0.01	0.01	GHz
C_d	[2.3e-4 2.3e-4]	[2e-4 2e-4]	[2e-4 2e-4]	nF
z_p select	[1 2]	[1 2]	[1 2]	
z_p (TX)	[12 30]	[12 30]	[12 30]	mm
z_p (NEXT)	[12 12]	[12 12]	[12 12]	mm
z_p (FEXT)	[12 30]	[12 30]	[12 30]	mm
z_p (RX)	[12 30]	[12 30]	[12 30]	mm
C_p	[1.1e-4 1.1e-4]	[1.1e-4 1.1e-4]	[1.1e-4 1.1e-4]	nF
R_0	50	50	50	Ohm
R_d	[55 55]	[55 55]	[55 55]	Ohm
f_r	0.75	0.75	0.75	*fb
c(0)	0.6	0.6	0.6	
c(-1)	[-0.15:0.05:0]	[-0.24:0.05:0]	[-0.25:0.05:0]	
c(-2)	[-.15:0.05:0]	[0:0.05:.6]	[0:0.05:0.6]	
c(1)	[-.35:0.05:0]	N/A	N/A	
g_DC	[-20:1:0]	[-18:1:0]	[-18:1:0]	dB
f_z	10.625	10.625	10.625	GHz
f_p1	10.625	10.625	10.625	GHz
f_p2	1.00E+99	1.00E+99	1.00E+99	GHz
A_v	0.45	0.45	0.45	V
A_fe	0.45	0.45	0.45	V
A_ne	0.65	0.65	0.65	V
L	4	4	4	
M	32	32	32	
N_b	15	16	16	UI
b_max(1)	0.5	0.75	0.5	
b_max(2..N_b)	0.2	0.375	0.2	
sigma_RJ	0.01	0.01	0.01	UI
A_DD	0.02	0.02	0.02	UI
eta_0	2.60E-08	2.60E-08	2.60E-08	V^2/GHz
SNR_TX	31.1	32	31.1	dB
R_LM	0.95	0.95	0.95	
DER_0	TBD	TBD	TBD	
COM Pass threshold	TBD	TBD	TBD	dB
Include PCB	1	1	1	Value
g_DC_HP	[-7:1:0]	[-6:1:0]	[-6:1:0]	
f_HP_PZ	0.6640625	0.6640625	0.6640625	GHz

Table 93A–3 parameters		
Parameter	**Setting**	**Units**
package_tl_gamma0_a1_a2	[0 1.734e-3 1.455e-4]	
package_tl_tau	6.141E-03	ns/mm
package_Z_c	90	Ohm

Table 92–12 parameters		
Parameter	**Setting**	
board_tl_gamma0_a1_a2	[0 4.114e-4 2.547e-4]	
board_tl_tau	6.191E-03	ns/mm
board_Z_c	110	Ohm
z_bp (TX)	151	mm
z_bp (NEXT)	72	mm
z_bp (FEXT)	72	mm
z_bp (RX)	151	mm

Conclusions

- 3m 26awg cables can be achieved in several ways
- Finalizing the COM limit should be simple since work has already been done to determine what limits are needed

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Thank You

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