Some Ideas for a Cost Effective OM3 PMD for HS Ethernet

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CORNING

Outline

- Some general observations
- More data on cabling lengths for Data Centers
- Recommended specification changes
  - Transceiver
  - Fiber
  - Connectors
- Supportable link lengths
- Recommendations

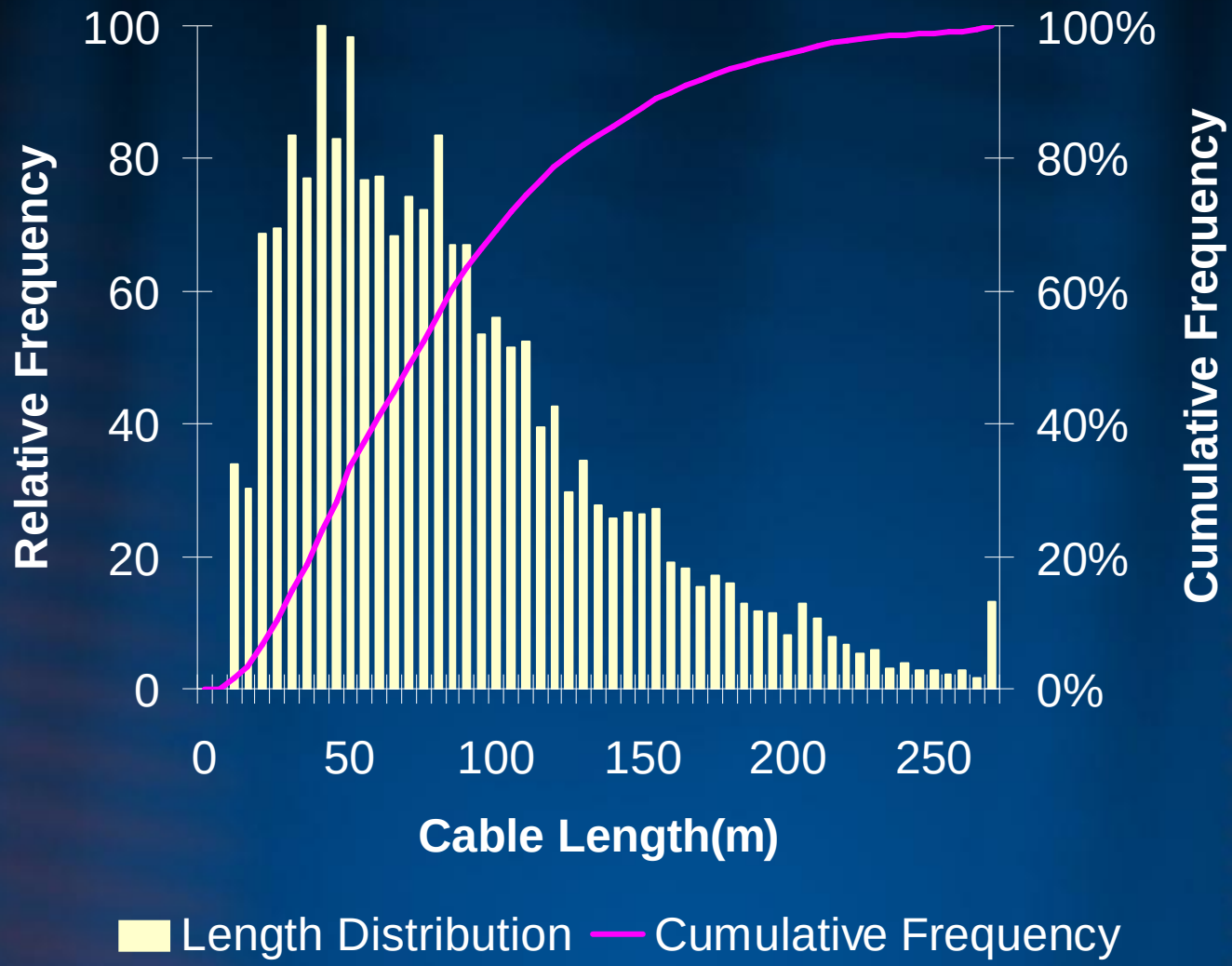
Observations

- A short reach PMD is needed to support high speed Ethernet
- 850nm multimode PMDs have proven cost effective for supporting short reach objectives
- 10GbE specifications challenged component vendors
- Parallel multimode solutions exist today
- Pre-terminated OM3 ribbon cable assemblies are shipping today
- Alternative solutions will be more costly at the component level

Data Center link length distributions

- Data on several thousand Corning trunk cable shipments
- Simulation designed to represent actual deployments
- Simulation assumptions
  - 50% of the links are comprised of two trunks
  - 20% of the links are comprised of three trunks
  - 30% of the links are point-to-point
  - Includes patchcords
- Yields short reach link length recommendation of 200m

Permanent link length distribution



Coverage rates at key lengths

Link Length	% Coverage
100m	69.22%
150m	87.65%
200m	95.78%
220m	97.74%
300m	100%

Proposed changes from 10GbE – transceiver

Attribute	IEEE 802.3ae	IEEE HSSG
Spectral width	.45 nm	.65 nm
Tx power OMA	-3.80 dBm	-5.25 dBm
RIN (OMA)	-130 dB/Hz	-128 dB/Hz

Desired by transceiver manufacturers - a more cost effective transceiver is anticipated for HSSG but the supportable link length is reduced

Proposed changes from 10GbE – fiber

Attribute	IEEE 802.3ae	IEEE HSSG
Cable attenuation	3.5 dB/km	3.0 dB/km
λ_0	1320 nm	1310 nm
s_0	.11 ps/nm^2•km	.0945 ps/nm^2•km

Tighter fiber specs proposed by Corning to facilitate relaxed transceiver specs for lower cost

Proposed changes from 10GbE – connectors

Attribute	IEEE 802.3ae	IEEE HSSG
Connector allocation	1.5 dB	2.0 dB

Prefer more connector loss allocation but proposing tighter spec to maximize length

Supportable link lengths

Spreadsheet by Del Hanson, David Cunningham, Piers Dawe, David Dolfi Agilent Technologies — Rev. 3.2/3 — This file 10GEPBud3_1_16a.xls of 17-Oct-01 — Model/format rev 3.1.16a of 31-Oct-01

Basics Input=	**Bold**	Ts(20-80)	**35**	ps	Case:	850nm serial	**newMMF**	Attenuation=	**3**	dB/km	NomSens OMA	**-11.10**	dBm	Margin	0.27	dB at									
Q=	**7.04**	Ts(10-90)	53	ps	*Target*	Target reach	**0.20**	0.2	*Fiber* at	850	nm	*Receiver* Refl Rx	**-12**	dB	*Answer!*		0.2	km							
Base Rate=	**10312** MBd	RIN(OMA)	**-128**	dB/Hz	*and*	L_start=	**0.05**	km	C_att=	0.86		Rec_BW=	**8,250**	MHz	Test Rx BW	**7500**	MHz								
Transmitter		RIN at MinER	-137.6	dB/Hz	*graph*	L_inc=	**0.01**	km	Attenuation=	3.11	dB/km	c_rx	**329**	ns.MHz											
Wavelength Uc	**840** nm	RIN_Coef=	**0.70**			Power Budget P=	5.85	dB	at	840	nm	T_rx(10-90)	39.9	ps	Test Source ER=										
Uw (see notes)	**0.65** nm	Det.Jitter	**6.0**	ps inc. DCD		Connections C	**2**	dB	Disp. min. Uo=	**1310**	nm	TP4 Eye	19	ps	*Test Tx*	**6.5**	dB								
Tx pwr OMA=	**-5.25** dBm	DCD_DJ=	**6**	ps TP3		Pwr.Bud.-Conn.Loss	3.85	dB	Disp. So=	**0.0945**	ps/nm^2*km	Opening		(=Tx ey	TestERpen	1.98	dBo								
Min. Ext Ratio=	3.00 dB	Effect. DJ=	0.00	(UI) ex DCD		C1=	**480**	ns.MHz	Disp. D1=	-97.54	ps/(nm.km)			fraction of 1/2 eye											
"Worst"ave.TxPwr	**-3.48** dBm	MPN k(OMA)	**0.3**			Reflection Noise factor	**0**	no units				RMS Baseline wander SD	**0.025**		V.E.C.P.	1.76	dBo								
Ext. ratio penalty	4.78 dBo	Tx eye height	68.9%			Effective Rate	10992	MBd	(not in use)	**10**															
Tx mask X1=	**0.3** UI	Refl Tx	**-12**	dB		Tb_eff=	91	ps	BWm=	**2000**	MHz*km	P_BLW(no ISI)	0.07	dB											Stressed
X2=	**0.4** UI	ModalNoisePen	**0.3**	dB		Effective Rec Eye	0.21	UI	Eff. BWm=	2.0E+03	MHz*km	P_BLW	0.07	dB											Rx sens
Y1=	**0.25**	Tx mask top	0.2	UI																					

L	Patt	Ch IL	D1.L	D2.L	BWcd	effBWm	Te	Tc	Pisi central	P Eye corners	P_DJ central	P_DJ corners	Preflection central	Beta	SDmpn	Pmpn	Prin	Pcross central	Ptotal central	<Ptotal corners	LP Pen central	Margin	OMA central
(km)	(dB)	(dB)	ps/nm	ps/nm	(MHz)	(MHz)	(ps)	(ps)	J=0, dB	(dB)	(dB)	(dB)	(dB)			(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dBm)
0.002	0.01	2.01	-0.20	0.00	1E+06	1.0E+06	53	66	0.75	0.22	0.00	0.00		-4E-03	0.00	0.00		0.05	1.11	1.33	1.1	2.7	-7.9
0.05	**0.16**	**2.16**	**-4.9**	**0.00**	**58,989**	**40,000**	**55**	**68**	**0.82**	**0.23**	**0.00**	**0.00**	**0**	**-0.11**	**0.00**	**0.00**	**0.21**	**0.09**	**1.6**	**1.8**	**1.4**	**2.3**	**-8.2**
0.06	0.19	2.19	-5.9	0.00	49,157	33,333	56	69	0.86	0.23	0.00	0.00	0	-0.13	0.00	0.00	0.20	0.09	1.6	1.9	1.5	2.2	-8.3
0.07	0.22	2.22	-6.8	0.00	42,135	28,571	57	69	0.90	0.23	0.00	0.00	0	-0.15	0.00	0.00	0.20	0.09	1.7	1.9	1.5	2.1	-8.3
0.08	0.25	2.25	-7.8	0.00	36,868	25,000	58	70	0.94	0.23	0.00	0.00	0	-0.18	0.01	0.00	0.20	0.10	1.8	2.0	1.5	2.1	-8.3
0.09	0.28	2.28	-8.8	0.00	32,771	22,222	59	71	1.00	0.23	0.00	0.00	0	-0.20	0.01	0.01	0.20	0.10	1.9	2.1	1.6	2.0	-8.4
0.10	**0.31**	**2.31**	**-9.8**	**0.00**	**29,494**	**20,000**	**61**	**72**	**1.05**	**0.23**	**0.00**	**0.00**	**0**	**-0.22**	**0.01**	**0.01**	**0.20**	**0.11**	**2.0**	**2.2**	**1.7**	**1.9**	**-8.4**
0.11	0.34	2.34	-10.7	0.00	26,813	18,182	62	74	1.12	0.24	0.00	0.00	0	-0.24	0.01	0.02	0.20	0.11	2.1	2.3	1.7	1.8	-8.4
0.12	0.37	2.37	-11.7	0.01	24,579	16,667	64	75	1.19	0.24	0.00	0.00	0	-0.26	0.01	0.02	0.20	0.12	2.2	2.4	1.8	1.6	-8.5
0.13	0.40	2.40	-12.7	0.01	22,688	15,385	65	76	1.27	0.24	0.00	0.00	0	-0.28	0.02	0.03	0.20	0.13	2.3	2.6	1.9	1.5	-8.5
0.14	0.43	2.43	-13.7	0.01	21,067	14,286	67	78	1.36	0.24	0.00	0.00	0	-0.31	0.02	0.04	0.20	0.14	2.5	2.7	2.0	1.4	-8.6
0.15	**0.47**	**2.47**	**-14.6**	**0.01**	**19,663**	**13,333**	**69**	**79**	**1.45**	**0.24**	**0.00**	**0.00**	**0**	**-0.33**	**0.02**	**0.05**	**0.20**	**0.15**	**2.6**	**2.9**	**2.2**	**1.2**	**-8.6**
0.16	0.50	2.50	-15.6	0.01	18,434	12,500	71	81	1.55	0.24	0.00	0.00	0	-0.35	0.02	0.07	0.20	0.17	2.8	3.0	2.3	1.1	-8.7
0.17	0.53	2.53	-16.6	0.01	17,350	11,765	72	83	1.66	0.24	0.00	0.00	0	-0.37	0.03	0.08	0.20	0.19	3.0	3.2	2.4	0.9	-8.7
0.18	0.56	2.56	-17.6	0.01	16,386	11,111	74	84	1.77	0.25	0.00	0.00	0	-0.39	0.03	0.10	0.21	0.21	3.1	3.4	2.6	0.7	-8.8
0.19	0.59	2.59	-18.5	0.01	15,523	10,526	77	86	1.89	0.25	0.00	0.00	0	-0.42	0.03	0.13	0.21	0.23	3.4	3.6	2.8	0.5	-8.9
0.20	**0.62**	**2.62**	**-19.5**	**0.01**	**14,747**	**10,000**	**79**	**88**	**2.02**	**0.25**	**0.00**	**0.00**	**0**	**-0.44**	**0.04**	**0.15**	0.22	**0.26**	**3.6**	**3.8**	**3.0**	**0.3**	**-8.9**
0.21	0.65	2.65	-20.5	0.01	14,045	9,524	81	90	2.16	0.25	0.00	0.00	0	-0.46	0.04	0.18	0.22	0.30	3.8	4.1	3.2	0.0	-9.0
0.22	0.68	2.68	-21.5	0.01	13,406	9,091	83	92	2.30	0.25	0.00	0.00	0	-0.48	0.04	0.22	0.23	0.34	4.1	4.3	3.4	-0.2	-9.1
0.23	0.71	2.71	-22.4	0.01	12,824	8,696	85	94	2.45	0.25	0.00	0.00	0	-0.50	0.05	0.26	0.24	0.39	4.4	4.6	3.6	-0.5	-9.2
0.24	0.75	2.75	-23.4	0.01	12,289	8,333	88	96	2.61	0.25	0.00	0.00	0	-0.53	0.05	0.30	0.25	0.46	4.7	4.9	3.9	-0.8	-9.3
0.25	**0.78**	**2.78**	**-24.4**	**0.01**	**11,798**	**8,000**	**90**	**98**	**2.77**	**0.25**	**0.00**	**0.00**	**0**	**-0.55**	**0.05**	**0.35**	0.26	**0.53**	**5.0**	**5.2**	**4.2**	**-1.1**	**-9.5**

Recommendations

- Strong consideration should be given to 10x10 parallel interconnects
  - Supports the distance requirements
  - Will prove cost effective
- Changes should be made to some component specifications
- Support the longest link that is possible
  - 200m recommended
  - Maximize application coverage at lowest cost