L2014-266

Proposal of OM2 applied to P802.3bm

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Presentation Summary

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Sorry for bothering about our late proposal in this stage.

Our customers require multi-mode optical fiber (MMF) cables with lower price in general data center. Major transmission distance range except mega date center is less than 30m (to 50m). As generally well known, price of OM3/OM4 is higher than that of OM2 with narrower bandwidth than OM3/OM4. According to Avago's spreadsheet, OM2 can transmit 30m at 100GbE (25Gbps, 4ch). In order to meet our customer requirements, we would like to propose OM2s with EMB wider than 700 / 1,200MHz.km.

In accordance with P802.3bm schedule, this proposal should be presented in maintenance activity, however, our customers expect the lower price MMF (OM2) are listed in P802.3bm at earlier stage. From the view of business, it would be very appreciated to discuss this matter before standardization in March of 2015.

Link model of transmission distance

Transmission distance in 100GbE (25Gbps, 4ch) was calculated in use of Avago's spreadsheet shown below setting bandwidth as parameter.

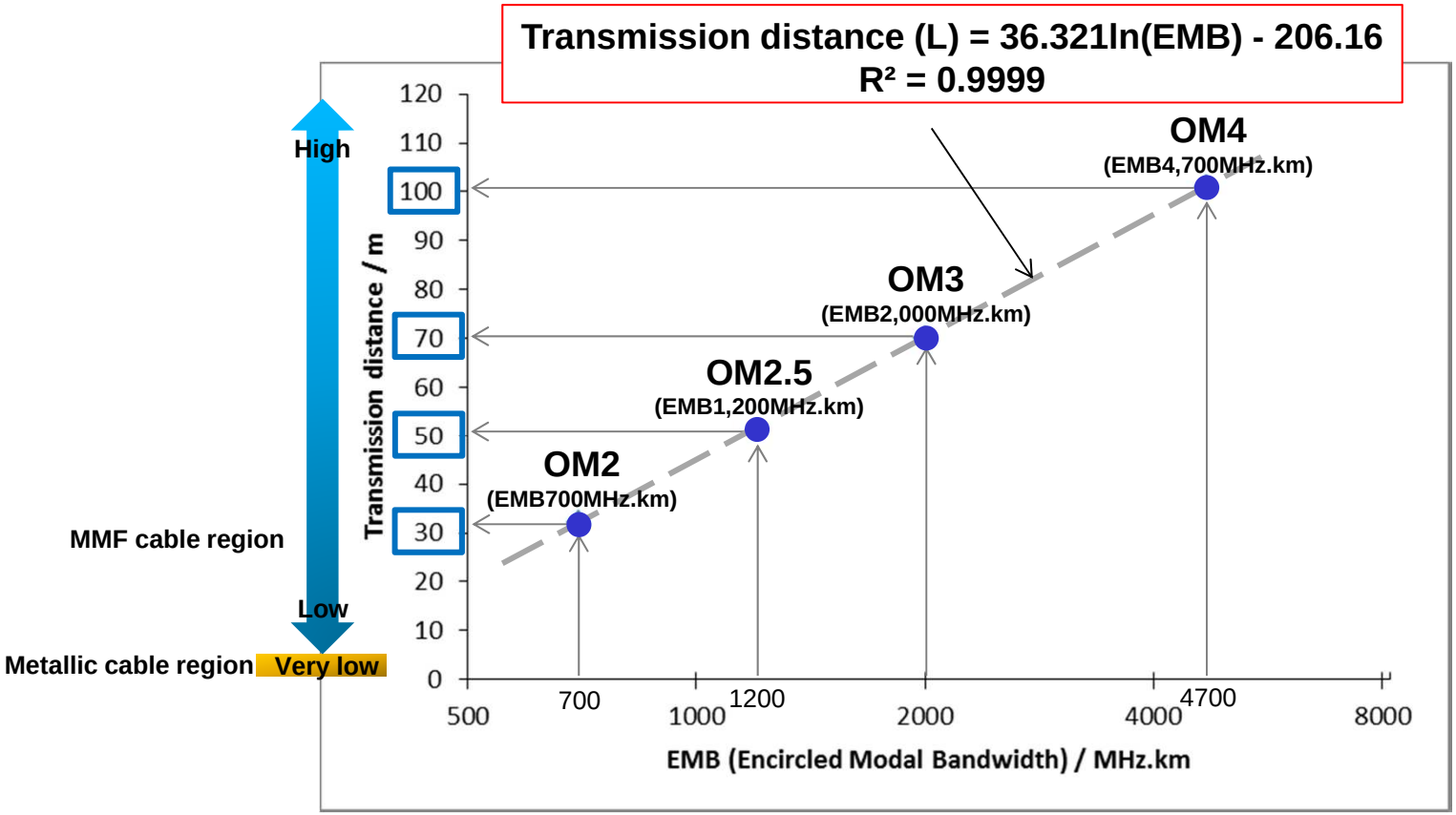
Spreadsheet by Del Hanson, David Cunningham, Piers Dawe, David Dolfi Agilent Technologies									Rev.	3.2/3	This file	10GEPBud3_1_16a.xls			of	17-Oct-01	
Basics Input=	**Bold**		Ts(20-80)	**21.0**	ps	Case: 850nm serial	**newMMF**		Attenuation=	**3.5**	dB/km	Model/format rev	3.1.16a		of	31-Oct-01	
Q=	**3.891**		Ts(10-90)	31.9	ps	*Target* Target reach	0.070	km	*Fiber* at	850	nm	NomSens OMA	**-11.20**	dBm	Margin	0.17	dB at
Base Rate=	**25781**	MBd	RIN(OMA)	**-128.0**	dB/Hz	*and* L_start=	**0.02**	km	C_att=	1.00		*Receive* Refl Rx	**-12**	dB	*Answer!*		0.07 km
Transmitter			RIN at MinER	-135.3	dB/Hz	*graph* L_inc=	**0.005**	km	Attenuation=	3.62	dB/km	Rec_BW=	**18047**	MHz	est Rx BW	**19,336**	MHz
Wavelength Uc	**840**	nm	RIN_Coef=	**0.70**		Power Budget P=	8.20	dB	at	840	nm	c_rx	**329**	ns.MHz			
Uw (see notes)	**0.60**	nm	DJ+ & TP4eye	**21.4**	ps inc. DCD	Connections etc	**1.50**	dB	Disp. min. Uo=	**1316.0**	nm	T_rx(10-90)	18.2	ps	Test Source ER=		
Tx pwr OMA=	**-3.00**	dBm	DCD_DJ=	**1.9**	ps TP3	Pwr.Bud.-Conn.Loss	6.7	dB	Disp. So=	**0.1028**	ps/nm^2*km	TP4 Eye	8	ps	*Test Tx*	**6.5**	dB
Min. Ext Ratio=	4.00	dB	Effect. DJ=	0.53	(UI) ex DCD	C1=	**480**	ns.MHz	Disp. D1=	-108.41	ps/(nm.km)	Opening		(=Tx ey	TestERpen	1.98	dBo
Worst"ave.TxPwr	**-2.35**	dBm	MPN k(OMA)	**0.3**		Reflection Noise factor	**0**	no units				RMS Baseline wander SD	**0.025**	fraction	of 1/2 eye		
Ext. ratio penalty	3.66	dBo	Tx eye height	10.4%		Effective Rate	27138	MBd	(not in use)	**10**					V.E.C.P.	4.87	dBo
Tx mask X1=	**0.3**	UI	Refl Tx	**-12**	dB	Tb_eff=	37	ps	BWm=	**2000**	MHz*km	P_BLW(no ISI)	0.02	dB			
X2=	**0.4**	UI	ModalNoisePen	**0.129**	dB	Effective Rec Eye	0.21	UI	Eff. BWm=	2.0E+03	MHz*km	P_BLW	0.02	dB			
Y1=	**0.25**		Tx mask top	0.2	UI												

L (km)	Patt (dB)	Ch IL (dB)	D1.L ps/nm	D2.L ps/nm	BWcd (MHz)	effBWm (MHz)	Te (ps)	Tc (ps)	Pisi central J=0, dB	P Eye corners (dB)	P_DJ central (dB)	P_DJ corners (dB)	Preflection central (dB)	Beta	SDmpn	Pmpn (dB)	Prin (dB)	Pcross central (dB)	Ptotal central (dB)	<Ptotal corners (dB)	LP Pen central (dB)	Margin (dB)	Stressed Rx sens OMA eye width (dBm)
0.002	0.01	1.51	-0.22	0.00	1E+06	######	32	37	2.20	0.24	1.71	3.80		-1E-02	0.00	0.00		0.40	4.45	6.78	4.4	2.2	-5.0
0.02	**0.07**	**1.57**	**-2.2**	**0.00**	**#####**	**######**	**32**	**37**	**2.28**	0.24	**1.72**	3.81	**0**	**-0.11**	**0.00**	**0.00**	**0.66**	**0.23**	**5.1**	7.4	**5.0**	**1.6**	**-5.6**
0.025	0.09	1.59	-2.7	0.00	#####	80,000	33	37	2.32	0.24	1.72	3.82	0	-0.14	0.00	0.00	0.66	0.23	5.2	7.5	5.1	1.5	-5.7
0.03	0.11	1.61	-3.3	0.00	95,828	66,667	33	38	2.38	0.24	1.72	3.83	0	-0.17	0.01	0.00	0.66	0.24	5.2	7.6	5.1	1.5	-5.7
0.035	0.13	1.63	-3.8	0.00	82,138	57,143	33	38	2.45	0.24	1.72	3.84	0	-0.19	0.01	0.00	0.66	0.24	5.3	7.7	5.2	1.4	-5.7
0.04	0.14	1.64	-4.3	0.00	71,871	50,000	34	39	2.53	0.24	1.73	3.85	0	-0.22	0.01	0.00	0.66	0.25	5.4	7.8	5.3	1.3	-5.7
0.045	**0.16**	**1.66**	**-4.9**	**0.00**	**63,885**	**44,444**	**34**	**39**	**2.61**	0.24	**1.73**	3.86	**0**	**-0.25**	**0.01**	**0.01**	**0.67**	**0.27**	**5.6**	8.0	**5.4**	**1.1**	**-5.8**
0.05	0.18	1.68	-5.4	0.00	57,497	40,000	35	40	2.71	0.24	1.74	3.88	0	-0.28	0.02	0.01	0.67	0.28	5.7	8.1	5.5	1.0	-5.8
0.055	0.20	1.70	-6.0	0.00	52,270	36,364	36	40	2.82	0.24	1.74	3.90	0	-0.30	0.02	0.01	0.68	0.30	5.9	8.3	5.7	0.8	-5.8
0.06	0.22	1.72	-6.5	0.00	47,914	33,333	36	41	2.94	0.25	1.75	3.93	0	-0.33	0.02	0.02	0.70	0.33	6.1	8.5	5.9	0.6	-5.9
0.065	0.24	1.74	-7.0	0.00	44,228	30,769	37	41	3.07	0.25	1.76	3.96	0	-0.36	0.03	0.02	0.72	0.36	6.3	8.7	6.1	0.4	-6.0
0.07	**0.25**	**1.75**	**-7.6**	**0.00**	**41,069**	**28,571**	**38**	**42**	**3.21**	0.25	**1.77**	3.99	**0**	**-0.39**	**0.03**	**0.03**	**0.75**	**0.39**	**6.5**	9.0	**6.28**	**0.17**	**-6.02**
0.075	0.27	1.77	-8.1	0.00	38,331	26,667	39	43	3.36	0.25	1.78	4.03	0	-0.42	0.03	0.04	0.78	0.44	6.8	9.3	6.5	-0.1	-6.1
0.08	0.29	1.79	-8.7	0.00	35,936	25,000	40	44	3.53	0.25	1.79	4.08	0	-0.44	0.04	0.05	0.82	0.50	7.1	9.6	6.8	-0.4	-6.2
0.085	0.31	1.81	-9.2	0.00	33,822	23,529	40	44	3.70	0.25	1.81	4.14	0	-0.47	0.04	0.06	0.87	0.58	7.5	10.0	7.2	-0.8	-6.3
0.09	0.33	1.83	-9.8	0.00	31,943	22,222	41	45	3.89	0.25	1.83	4.21	0	-0.50	0.05	0.07	0.94	0.69	7.9	10.5	7.5	-1.2	-6.5
0.095	**0.34**	**1.84**	**-10.3**	**0.00**	**30,261**	**21,053**	**42**	**46**	**4.09**	0.26	**1.85**	4.30	**0**	**-0.53**	**0.05**	**0.09**	**1.02**	**0.83**	**8.4**	11.1	**8.0**	**-1.7**	**-6.7**
0.10	0.36	1.86	-10.8	0.00	28,748	20,000	43	47	4.30	0.26	1.88	4.40	0	-0.55	0.06	0.11	1.12	1.04	8.9	11.7	8.6	-2.2	-6.9

http://www.ieee802.org/3/bm/public/may13/ExampleMMF%20LinkModel%201305-3.xlsx

Results of calculation

According to Avago's spreadsheet, transmission distance in 100GbE (25Gbps, 4ch) is in proportion to logarithm of EMB shown below. OM2 with EMB of 700 MHz.km can transmit 30m. Also, OM2 with EMB of 1,200 MHz.km can do 50m which is the major transmission distance range except mega data center.



Calculated in spread sheet in http://www.ieee802.org/3/bm/public/may13/ExampleMMF%20LinkModel%20%201305-3.xlsx

Proposal of OM2 applied to Draft P302.3bm (1)

Proposal of OM2 is described in tables of draft P802.3bm/D3.2 shown below and next slide.

Table 95-5-100GBASE-SR4 operating range

PMD type	Required operating range[a]
100GBASE-SR4	0.5 m to 30 m for OM2
	0.5 m to 50 m for OM2.5
	0.5 m to 70 m for OM3
	0.5 m to 100 m for OM4

[a]The RS-FEC correction function may not be bypassed for any operating distance.

Table 95-8-100GBASE-SR4 illustrative link power budget

Parameter	OM2	OM2.5	OM3	OM4	Unit
Effective modal bandwidth at 850 nm[a]	700	1200	2000	4700	MHz.km
Power budget (for max TxVEC)	8.2		8.2		dB
Operating distance	0.5 to 30	0.5 to 50	0.5 to 70	0.5 to 100	m
Channel insertion loss[b]	1.8	1.8	1.8	1.9	dB
Allocation for penalties c (for max TxVEC)	6.3		6.3		dB
Additional insertion loss allowed	0.1	0.1	0.1	0.1	dB

[a]per IEC 60793-2-10.
[b]The channel insertion loss is calculated using the maximum distance specified in Table 95-5 and cabled optical fiber attenuation of 3.5 dB/km at 850 nm plus an allocation for connection and splice loss given in 95.11.2.1.
[c]Link penalties are used for link budget calculations They are not requirements and are not meant to be tested.

Proposal of OM2 applied to Draft P302.3bm (2)

Table 95-12-Fiber optic cabling (channel) characteristics for 100GBASE-SR4

Description	OM2	OM2.5	OM3	OM4	Unit
Operating distance (max)	30	50	70	100	m
Cabling Skew (max)	79		79		ns
Cabling Skew Variation[a] (max)	2.4		2.4		ns
Channel insertion loss[b] (max)	1.8	1.8	1.8	1.9	dB
Channel insertion loss (min)	0		0		dB

[a]An additional 400 ps of Skew Variation could be caused by wavelength changes, which are attributable to the transmitter not the channel.
[b]These channel insertion loss values include cable loss plus 1.5 dB allocated for connection and splice loss, over the wavelength range 840 nm to 860 nm.

Table 95-13-Optical fiber and cable characteristics

Description	OM2[a]	OM2.5	OM3[b]	OM4[c]	Unit
Nominal core diameter	50		50		µm
Nominal fiber specification wavelength	850		850		nm
Effective modal bandwidth (min)[d]	700	1200	2000	4700	MHz.km
Cabled optical fiber attenuation (max)	3.5		3.5		dB/km
Zero dispersion wavelength (l_0)	$1295 \leq \lambda_0 \leq 1340$				nm
Chromatic dispersion slope (max) (S_0)	0.105 for $1295 \leq \lambda_0 \leq 1310$ and $0.000375 \times (1590 - \lambda_0)$ for $1310 \leq \lambda_0 \leq 1340$				ps/nm^2km

[a]IEC 60793-2-10 type A1a.1
[b]IEC 60793-2-10 type A1a.2
[c]IEC 60793-2-10 type A1a.3
[d]When measured with the launch conditions specified in Table 95-6