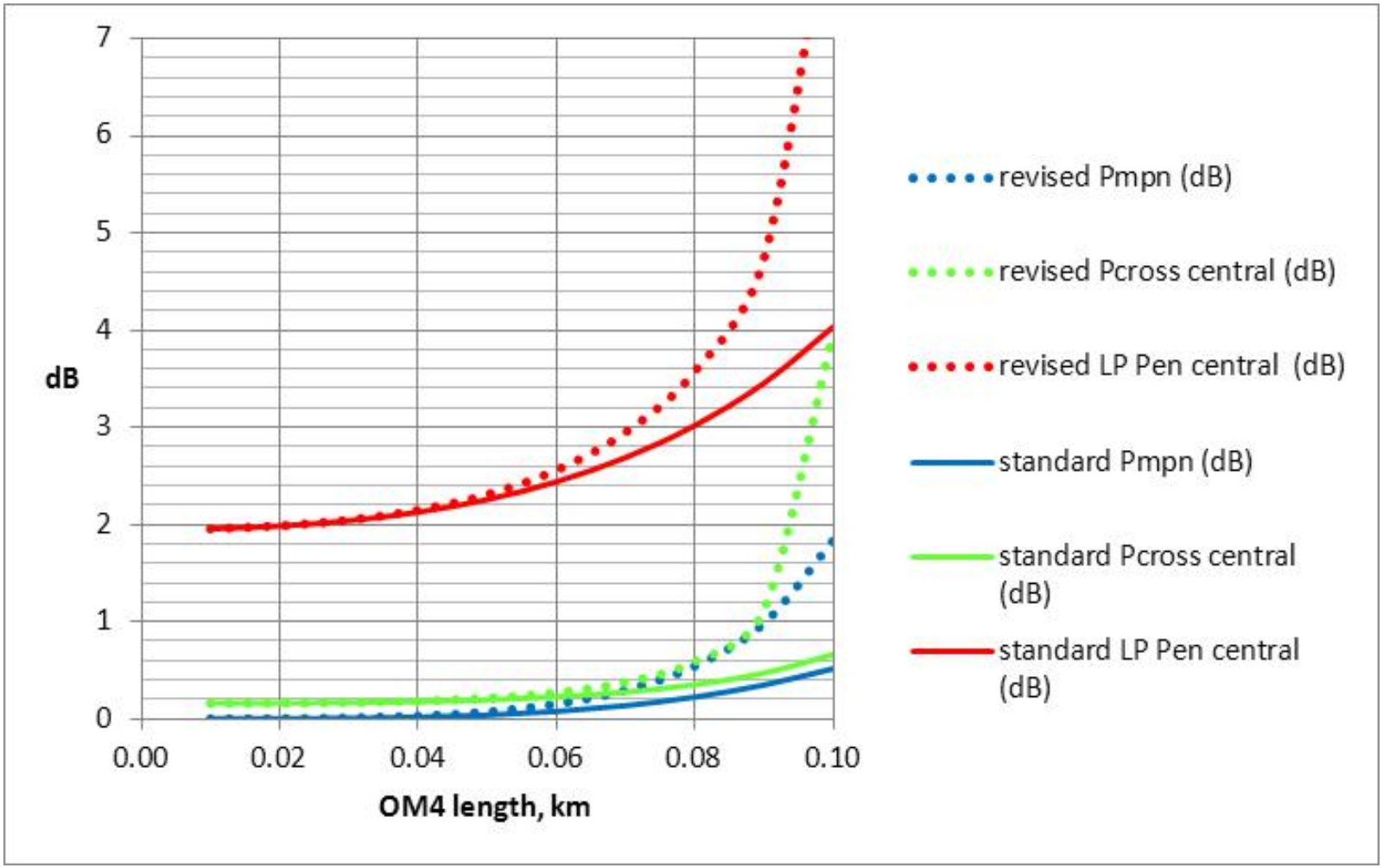
Standard spreadsheet model vs proposed revised MPN treatment model: an example

Jonathan king, using the first draft spreadsheet revision of MPN from Petar Pepeljugoski

Example: 100m OM4 penalties



OM4, 100m link, standard model

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)	**16**	ps	Case: 850nm serial	**newMMF**		Attenuation=	**3.5**	dB/km	Model/format rev	3.1.16a		of	31-Oct-01	
Q=	**7.04**		Ts(10-90)	24	ps	*Target* Target reach	**0.10**	km	*Fiber* at	850	nm	NomSens OMA	**-7.61**	dBm	Margin	0.72	dB at
Base Rate=	**25781**	MBd	RIN(OMA)	**-130**	dB/Hz	*and* L_start=	**0.0**	km	C_att=	1.00		*Receive* Refl Rx	**-12**	dB	*Answer!*		0.1 km
Transmitter			RIN at MinER	-139.6	dB/Hz	*graph* L_inc=	**0.01**	km	Attenuation=	3.62	dB/km	Rec_BW=	#####	MHz	est Rx BW	**18750**	MHz
Wavelength Uc	**840**	nm	RIN_Coef=	**0.70**		Power Budget P=	6.61	dB	at	840	nm	c_rx	**329**	ns.MHz			
Uw (see notes)	**0.65**	nm	Det.Jitter	**4.7**	ps inc. DCD	Connections C	**1.5**	dB	Disp. min. Uo=	**1316**	nm	T_rx(10-90)	16.0	ps	Test Source ER=		
Tx pwr OMA=	**-1.00**	dBm	DCD_DJ=	**2.3273**	ps TP3	Pwr.Bud.-Conn.Loss	5.11	dB	Disp. So=	**0.1028**	ps/nm^2*km	TP4 Eye	8	ps	*Test Tx*	**6.5**	dB
Min. Ext Ratio=	3.00	dB	Effect. DJ=	0.07	(UI) ex DCD	C1=	**480**	ns.MHz	Disp. D1=	-108.41	ps/(nm.km)	Opening		(=Tx ey	TestERpen	1.98	dBo
'Worst"ave.TxPwr	**-5.0**	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	4.78	dBo	Tx eye height	58.4%		Effective Rate	27427	MBd	(not in use)	**10**					V.E.C.P.	2.28	dBo
Tx mask X1=	**0.3**	UI	Refl Tx	**-12**	dB	Tb_eff=	36	ps	BWm=	**4400**	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=	######	MHz*km	P_BLW	0.07	dB			Rx sens
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)	OMA central (dBm)
0.002	0.01	1.51	-0.22	0.00	1E+06	######	24	29	1.06	0.23	0.02	0.17		-1E-02	0.00	0.00		0.09	1.48	1.86	1.5	3.6	-3.6
0.00	**0.00**	**1.50**	**0.0**	**0.00**	**#DIV/0!**	**#DIV/0!**	**####**	**###**	**#####**	**####**	**#####**	**####**	**####**	**0.00**	**0.00**	**0.00**	**#####**	**#####**	**#####**	**####**	**#DIV/0!**	**####**	**#####**
0.01	0.04	1.54	-1.1	0.00	#####	######	24	29	1.07	0.23	0.02	0.17	0	-0.06	0.00	0.00	0.40	0.16	2.0	2.4	2.0	3.1	-4.0
0.02	0.07	1.57	-2.2	0.00	#####	######	25	29	1.10	0.23	0.02	0.17	0	-0.12	0.00	0.00	0.40	0.16	2.1	2.4	2.0	3.1	-4.1
0.03	0.11	1.61	-3.3	0.00	88,457	######	25	30	1.16	0.24	0.02	0.17	0	-0.18	0.01	0.01	0.39	0.17	2.1	2.5	2.0	3.0	-4.1
0.04	0.14	1.64	-4.3	0.00	66,342	######	26	30	1.23	0.24	0.02	0.17	0	-0.24	0.01	0.02	0.38	0.18	2.3	2.7	2.1	2.8	-4.1
0.05	**0.18**	**1.68**	**-5.4**	**0.00**	**53,074**	**88,000**	**26**	**31**	**1.32**	**0.24**	**0.02**	**0.17**	**0**	**-0.30**	**0.02**	**0.04**	**0.38**	**0.19**	**2.4**	**2.8**	**2.3**	**2.7**	**-4.2**
0.06	0.22	1.72	-6.5	0.00	44,228	73,333	27	32	1.44	0.24	0.02	0.18	0	-0.36	0.03	0.08	0.38	0.23	2.7	3.1	2.4	2.5	-4.3
0.07	0.25	1.75	-7.6	0.00	37,910	62,857	28	33	1.58	0.24	0.02	0.18	0	-0.42	0.04	0.14	0.38	0.27	2.9	3.3	2.7	2.2	-4.4
0.08	0.29	1.79	-8.7	0.00	33,171	55,000	30	34	1.74	0.24	0.02	0.18	0	-0.49	0.04	0.22	0.38	0.35	3.3	3.7	3.0	1.8	-4.6
0.09	0.33	1.83	-9.8	0.00	29,486	48,889	31	35	1.92	0.25	0.02	0.18	0	-0.55	0.05	0.35	0.39	0.47	3.8	4.2	3.5	1.3	-4.8
0.10	**0.36**	**1.86**	**-10.8**	**0.00**	**26,537**	**44,000**	**32**	**36**	**2.13**	**0.25**	**0.02**	**0.18**	**0**	**-0.61**	**0.07**	**0.52**	**0.40**	**0.66**	**4.4**	**4.8**	**4.0**	**0.7**	**-5.1**

OM4, 100m link, revised model

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	
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	Q=	7.04		Ts(10-90)	24	ps	*Target* Target reach	0.10	km	*Fiber* at	850	nm	NomSens OMA	-7.61	dBm	Margin	-3.90	dB at	
	Base Rate=	25781	MBd	RIN(OMA)	-130	dB/Hz	*and* L_start=	0.0	km	C_att=	1.00		*Receive* Refl Rx	-12	dB	*Answer!*	0.1 km		
Transmitter				RIN at MinER	-139.6	dB/Hz	*graph* L_inc=	0.01	km	Attenuation=	3.62	dB/km	Rec_BW=	#####	MHz	est Rx BW	18750	MHz	
Wavelength Uc	840	nm		RIN_Coef=	0.70		Power Budget P=	6.61	dB	at	840	nm	c_rx	329	ns.MHz				
Uw (see notes)	0.65	nm		Det.Jitter	4.7	ps inc. DCD	Connections C	1.5	dB	Disp. min. Uo=	1316	nm	T_rx(10-90)	16.0	ps	Test Source ER=			
Tx pwr OMA=	-1.00	dBm		DCD_DJ=	2.3273	ps TP3	Pwr.Bud.-Conn.Loss	5.11	dB	Disp. So=	0.1028	ps/nm^2*km	TP4 Eye	8	ps	*Test Tx*	6.5	dB	
Min. Ext Ratio=	3.00	dB		Effect. DJ=	0.07	(UI) ex DCD	C1=	480	ns.MHz	Disp. D1=	-108.41	ps/(nm.km)	Opening		(=Tx ey	TestERpe	1.98	dBo	
Worst"ave.TxPwr	-5.0	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	4.78	dBo		Tx eye height	58.4%		Effective Rate	27427	MBd	(not in use)	10					V.E.C.P.	2.28	dBo	
Tx mask X1=	0.3	UI		Refl Tx	-12	dB	Tb_eff=	36	ps	BWm=	4400	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=	4.4E+03	MHz*km	P_BLW	0.07	dB			Rx sens	

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)	OMA central (dBm)
0.002	0.01	1.51	-0.22	0.00	1E+06	######	24	29	1.06	0.23	0.02	0.17		-1E-02	0.000	0.00		0.09	1.48	1.86	1.5	3.6	1.1
0.00	0.00	1.50	0.0	0.00	#####	######	24	29	1.06	0.23	0.02	0.17	0	0.00	0.000	0.00	0.40	0.16	1.9	2.3	1.9	3.2	0.6
0.01	0.04	1.54	-1.1	0.00	#####	######	24	29	1.07	0.23	0.02	0.17	0	-0.06	0.001	0.00	0.40	0.16	2.0	2.4	2.0	3.1	0.6
0.02	0.07	1.57	-2.2	0.00	#####	######	25	29	1.10	0.23	0.02	0.17	0	-0.12	0.003	0.00	0.40	0.16	2.1	2.4	2.0	3.1	0.6
0.03	0.11	1.61	-3.3	0.00	88,436	######	25	30	1.16	0.24	0.02	0.17	0	-0.18	0.007	0.01	0.39	0.17	2.2	2.5	2.0	3.0	0.5
0.04	0.14	1.64	-4.3	0.00	66,333	######	26	30	1.23	0.24	0.02	0.17	0	-0.24	0.012	0.03	0.38	0.18	2.3	2.7	2.1	2.8	0.5
0.05	0.18	1.68	-5.4	0.00	53,069	87,991	26	31	1.32	0.24	0.02	0.17	0	-0.30	0.019	0.07	0.38	0.21	2.5	2.9	2.3	2.6	0.4
0.06	0.22	1.72	-6.5	0.00	44,225	73,328	27	32	1.44	0.24	0.02	0.18	0	-0.36	0.026	0.15	0.38	0.27	2.8	3.2	2.6	2.3	0.2
0.07	0.25	1.75	-7.6	0.00	37,908	62,854	28	33	1.58	0.24	0.02	0.18	0	-0.42	0.035	0.30	0.38	0.38	3.2	3.6	2.9	1.9	0.0
0.08	0.29	1.79	-8.7	0.00	33,170	54,999	30	34	1.74	0.24	0.02	0.18	0	-0.49	0.045	0.54	0.38	0.59	3.9	4.3	3.6	1.2	-0.4
0.09	0.33	1.83	-9.8	0.00	29,485	48,888	31	35	1.92	0.25	0.02	0.18	0	-0.55	0.055	0.98	0.39	1.12	5.1	5.5	4.7	0.1	-1.2
0.10	0.36	1.86	-10.8	0.00	26,537	44,000	32	36	2.13	0.25	0.02	0.18	0	-0.61	0.065	1.83	0.40	3.96	9.0	9.4	8.7	-3.9	-3.5

- comments
  - Much faster blow up of MPN with reach
  - Further study needed !