Wide Wavelength Division Multiplexing (WWDM) Interface Specification Proposal For 10 Gb/s Ethernet Fiber Optic Link

Del Hanson
Agilent Technologies
Fiber Optic Communications Division
350 W. Trimble Road
San Jose, CA 95131
Phone: 408-435-6246
email: del_hanson@agilent.com

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Outline

- GbE Clause 38 1000BASE-LX Specification Extension Issues For 10 GbE WWDM Interface
- Proposed Equivalents For Tables 38-6, -7, -8, -9
- GbE Jitter Budget; Table 38-10
- Hari Interface Jitter Budget Proposal
- Proposed WWDM Link Jitter Budget
- Conclusions

GbE 1000BASE-LX Specification Extension Issues For 10 GbE WWDM

- Commonality Between 1000BASE-LX & WWDM
  - 1300 nm LDs & Single Mode Fiber Launch
  - Dual Use With Both Installed MMF & SMF
- New Issues With Four Separate Wavelengths & DFBs
  - Wavelength Separation, Tolerances & Cross Talk
  - DFB Side-Mode Suppression Ratio (SMSR)
- Support For HSSG Agreed Link Lengths & Fiber Types
  - 300 m Of Installed Or New 62MMF & 50MMF
  - 2 km & 10 km Of SMF

Figure 38-1 & Table 38-6 Equivalents

Figure 38-1 (equivalent for WWDM)
(This can be the same for WWDM on a per channel basis)

Table 38-6 (equivalent for WWDM)
Operating range for 10000BASE-LX WWDM over each optical fiber type

Fiber type	Modal bandwidth @ 1300 nm (min. overfilled launch) (MHz*km)	Minumum range (meters)
62.5 um MMF	500	2-300
50 um MMF	400	2-240
50 um MMF	500	2-300
10 um SMF	N/A	2-10,000

Table 38-7 Equivalent For WWDM

Table 38-7 (equivalent for WWDM)
10000BASE-LX WWDM transmit characteristics

Description	62.5 um MMF 50 um MMF 10 um SMF	Unit
Transmitter type	Longwave Laser	
Signaling speed per channel (range)	3.125 +/- 100 ppm	GBd
Wavelength (range), four channels	1270 to 1355	nm
Channel center wavelengths	1275.7, 1300.2, 1324.7, 1349.2 +/- 5.7 nm	nm
Channel Separation	24.5	nm
Trise/Tfall (max. 20-80% response time)	100	ps
Side-mode suppression ratio (SMSR), (min)	0.0	dB
RMS spectral width (max)	0.72	nm
Average launch power, four channels (max)	3.5	dBm
Average launch power, per channel (max)	-2.5	dBm
Average launch power per channel (min)	-7.5	dBm
Average launch power of OFF transmitter, per channel (max)	-30	dBm
Extinction ratio, (min)	7	dB
RIN (max)	-120	dB/Hz

Table 38-8 Equivalent For WWDM

Table 38-8 (equivalent for WWDM)
10000BASE-LX WWDM receive characteristics

Description	62.5 um MMF 50 um MMF	10 um SMF	Unit
Signaling speed per channel (range)	3.125 +/- 100 ppm		GBd
Wavelength (range), four channels	1270 to 1355		nm
Channel center wavelengths	1275.7, 1300.2, 1324.7, 1349.2 +/- 5.7 nm		nm
Channel Separation	24.5		nm
Average receive power, four channels (max)	3.5		dBm
Average receive power, per channel (max)	-2.5		dBm
Return loss (min)	12		dB
Receive electrical 3 dB upper cuttoff frequency (max)	3750		MHz
Receive sensitivity	-15.5	-16.5	dBm
Stressed receive sensitivity	-10.0	-15.0	dBm
Vertical eye closure penalty	3.6	0.6	dB

Table 38-9 Equivalent For WWDM

Table 38-9 (equivalent for WWDM)
Worst case 10000BASE-LX WWDM link power budget and penalties

Parameter	62.5 um MMF	50 um MMF		10 um SMF	Unit
Modal bandwidth as measured at 1300 nm, (min, overfilled launch)	500	400	500	N/A	MHz* km
Link power budget	8.0	8.0	8.0	9.0	dB
Operating distance	300	240	300	10,000	m
Channel insertion loss	1.96	1.87	1.96	7.14	dB
Link power penalties	4.67	5.17	5.17	1.78	dB
Unallocated margin in link power budget	1.37	0.96	0.87	0.08	dB

GbE Table 38-10, With Analysis

Line Rate (MBd)=	1250		Input	BOLD	UI Parameters				
Baud Period (ps)=	800								
		Table 38-10							
	Total		**DJ**		**DCD**			**RJ**	
	TJ(UI)	TJ(ps)	DJ(UI)	DJ(ps)	rms, (ps)	%of DJ		RJ(UI)	RJ(ps)
SerDes Tx, TP1	0.240	192.0	**0.100**	80.0				**0.140**	112.0
FO Tx Added	0.284	227.2	**0.100**	80.0				**0.184**	147.2
FO Tx Out, TP2	0.431	345.0	0.200	160.0	46.0	29		0.231	185.0
Fiber Added	0.170	136.0	**0.050**	40.0				**0.120**	96.0
Fiber Out, TP3	0.510	408.4	0.250	200.0	65.1	33		0.260	208.4
FO Rx Added	0.332	265.6	**0.212**	169.6				**0.120**	96.0
FO Rx Out, TP4	0.749	599.0	0.462	369.6	79.7	22		0.287	229.4
SerDes Rx Window	0.251	201.0							

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Hari-To-Optics Jitter Proposal

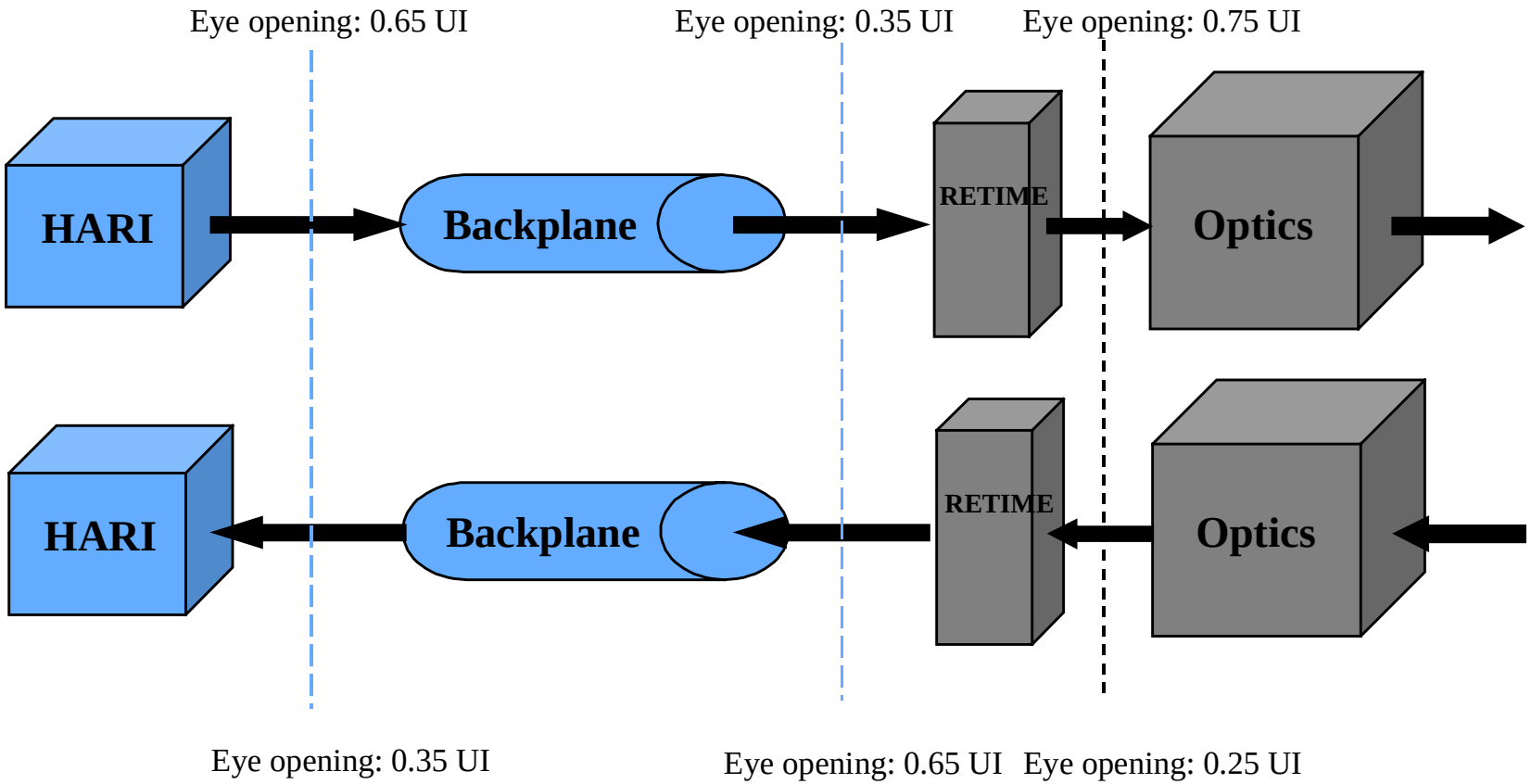

Table 38-10 Equivalent For WWDM

Line Rate (MBd)=	**3125**	Input	**BOLD**	UI Parameters					
Baud Period (ps)=	320								
	Total		**DJ**		**DCD**			**RJ**	
	TJ(UI)	TJ(ps)	DJ(UI)	DJ(ps)	rms, (ps)	% of DJ		RJ(UI)	RJ(ps)
SerDes Tx, TP1	0.240	76.8	**0.100**	32.0				**0.140**	44.8
FO Tx Added	0.284	90.9	**0.100**	32.0				**0.184**	58.9
FO Tx Out, TP2	0.431	138.0	0.200	64.0	18.4	29		0.231	74.0
Fiber Added	0.170	54.4	**0.050**	16.0				**0.120**	38.4
Fiber Out, TP3	0.510	163.4	0.250	80.0	26.0	33		0.260	83.4
FO Rx Added	0.332	106.2	**0.212**	67.8				**0.120**	38.4
FO Rx Out, TP4	0.749	239.6	0.462	147.8	31.9	22		0.287	91.8
SerDes Rx Window	0.251	80.4							

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Conclusions

- 10 GbE WWDM Has A Single Interface Which Leverages GbE 1000BASE-LX Methodology
- WWDM Supports All Installed Or New MMF Cases; Plus The 2 km & 10 km SMF Cases
- Proposed Interface Specifications Are Based On Readily Available Optoelectronic Device & Circuit Technology
- Further Work May Refine Some Specification Parameters