1310 nm serial eye mask and jitter

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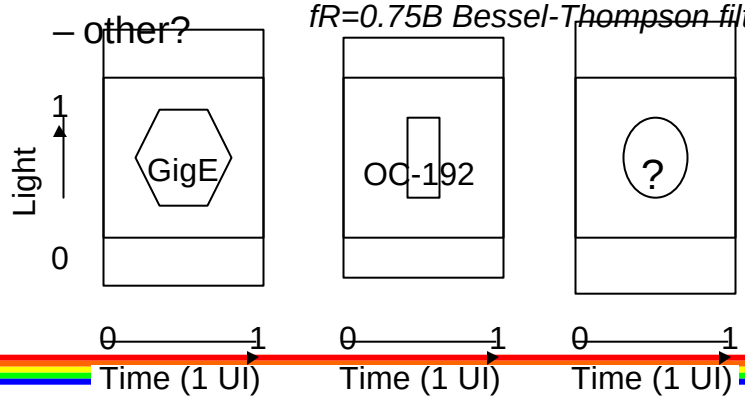
1. Eye mask

- What eye mask goes with the 1310 nm serial PMD?
  - Scaled Gigabit Ethernet?
  - OC-192?
  - other?

Always measured through standard fR=0.75B Bessel-Thompson filter



Can we scale the eye?

- Lasers don't follow Moore's law
- 10G serial transmitter relatively slower than GigE: 20-80% risetime 0.4 UI vs. 0.325 UI
- Theoretical (spreadsheet) transmitter (Ts = 0.41 UI) fails the GigE eye mask
- Sample actual lasers from four vendors fail the mask but can make low BER links
- Summary: No, too harsh

Can we use the SONET eye?

- Eye is smaller in both time and intensity
  - Easier for transmitter
  - Harder for receiver
- Eye is rectangular - no "points"
  - Causes some concern to receiver designers and jitter specification
  - Why did the telecoms people leave them out at OC-48 and OC-192?
- Eye is allowed to float in time
  - Extra complexity in Rx - costs?
- Theoretical transmitter passes this eye, real lasers struggle
- Summary: not ideal

How to build a new eye mask

- Desirable features
  - Hexagonal shape
  - Fixed, central position
  - Dimensions to suit risetime: height similar to OC-192 eye
  - Length to match jitter budget
- Different PMDs therefore may need different masks

2. Jitter budget

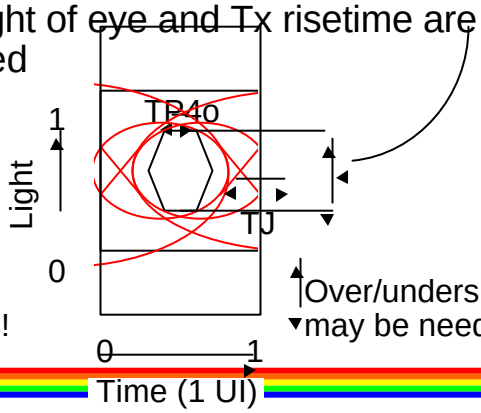
- Issues as part 1:
  - Lasers struggle to keep up with the silicon
  - Clock (VCO) jitter might be an issue too
  - But fast decision circuits (Rx) are possible
  - Worth re-allocating a little jitter from receiver to transmitter
- TP1 and TP4 aren't compliance points because not exposed standardised interfaces

Jitter budget options

		Peak-	*to-peak*	*Jitter*	*to 10^-12 BER*		*Comments*
Standard	Test point	Total	DJ deterministic jitter	DCD duty cycle distortion	RJ random jitter	TP4 eye opening (Rx)	
GigE	TP2 (Tx)	0.431	0.2	0.058	(0.231)		
802.3z	TP3 (Rx)	0.51	0.25	0.081	(0.26)	0.25	
Hanson	TP2 (Tx)	0.431	0.2	0.082	(0.231)		
1310 serial	TP3 (Rx)	0.51	0.25		(0.25)	0.25	
SONET	Tx	(0.2 words)			(0.14 ish)		Different measurement method? RJ at OC-192 not spec'd: ("unmeasurable") – figure from OC-48.
OC-192	Rx					0.2	
Proposed	TP2 (Tx)	0.475	0.225	0.082	0.25		
Straw man	TP3 (Rx)	0.55	0.25	0.091	0.3	0.2	

Jitter budget determines eye

- Translating strawman jitter budget into eye mask
  - Top of eye is TP4 eye opening long
  - Total length of eye is 1 - TJ - margin
  - Height of eye and Tx risetime are now linked

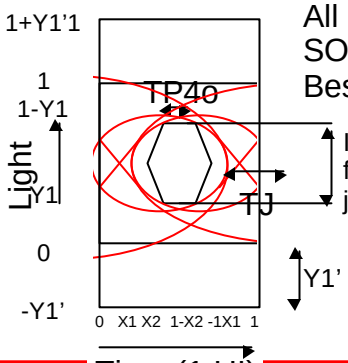


"0" is not darkness!

Over/undershoot limits may be needed

Strawman eye mask values

X1	X2	Y1	(Inner eye height)	Y1'
0.3	0.4	0.25 to 0.3	0.4 to 0.5	0.3 to 0.4?



All eye measurements through SONET standard fR=7.5 GHz Bessel-Thompson filter

Inner eye height must be <0.55 for 40ps (0.41 UI) rise time with jitter

Y1' >= Y1 ?

What knock-on changes to Draft 1.0 ?

Table	Description	Old value	New value	Comments
38-8 (now 52-9)	Stressed receive sensitivity	-11.45	-11.30	
38-9 (now 52-10)	Link power penalties	2.27	2.11	
"	Margin	0.69	0.85	
38-10 (now 52-11)	Jitter			See page 7

The apparent improvement is an illusion

Summary: no significant change to dB values

Conclusions (1310 serial)

- GigE mask is too harsh
- OC-192 mask is not quite appropriate:
  - May still be too harsh?
  - Fixed-position masks are appropriate for Ethernet costs
  - Hexagonal masks are better (?) than rectangular
- Eye mask dimensions follow jitter and risetime specs
- Updated eye jitter and dB values proposed
- These values could be used in draft standard until we have more and better information