Advantage of Linear Interface for 4x and 10x Links

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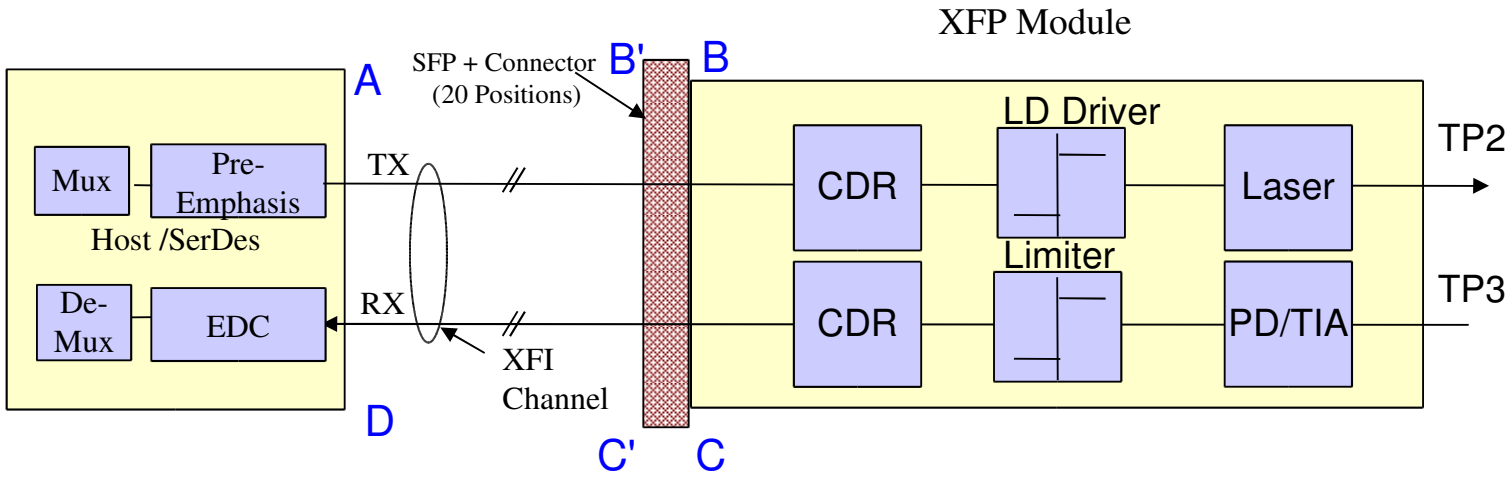
Overview

- Super condensed summary of XFI and SFI specifications
  - For detail specification please see SFF INF-8077i (XFP) and SFF-8431 (SFP+).
- The current assumption is not to use CDR in the 4x and 10x modules due to power dissipation.
- SFI single lane limiting specifications is very difficult and closing 4x and 10x link even more difficult.
- Linear specifications with EDC can provide the extra margin to close the link without using CDR in the module.
  - EDC also allow using cost and slower lasers.

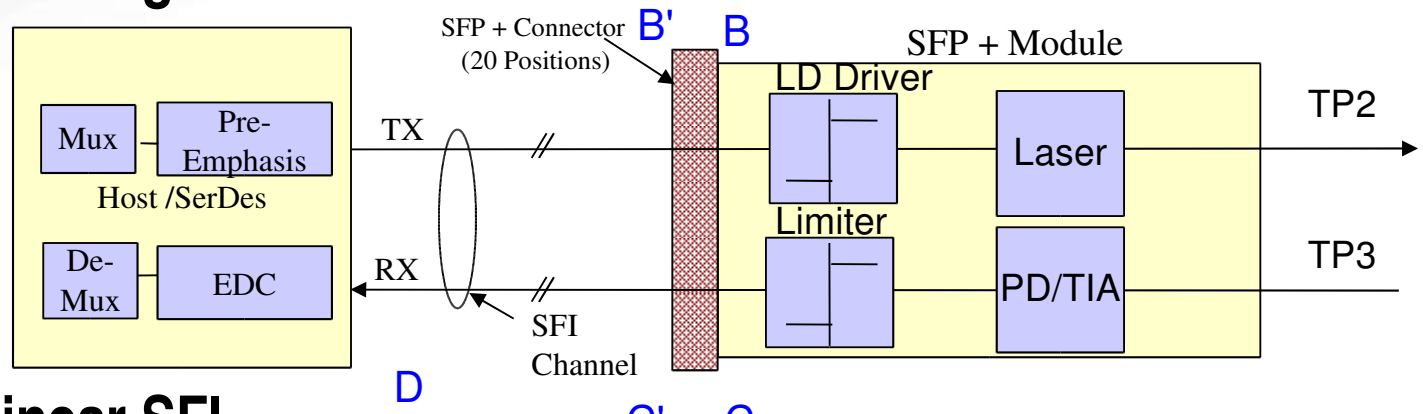
Block Digram of XFI

- **Limiting interface only**

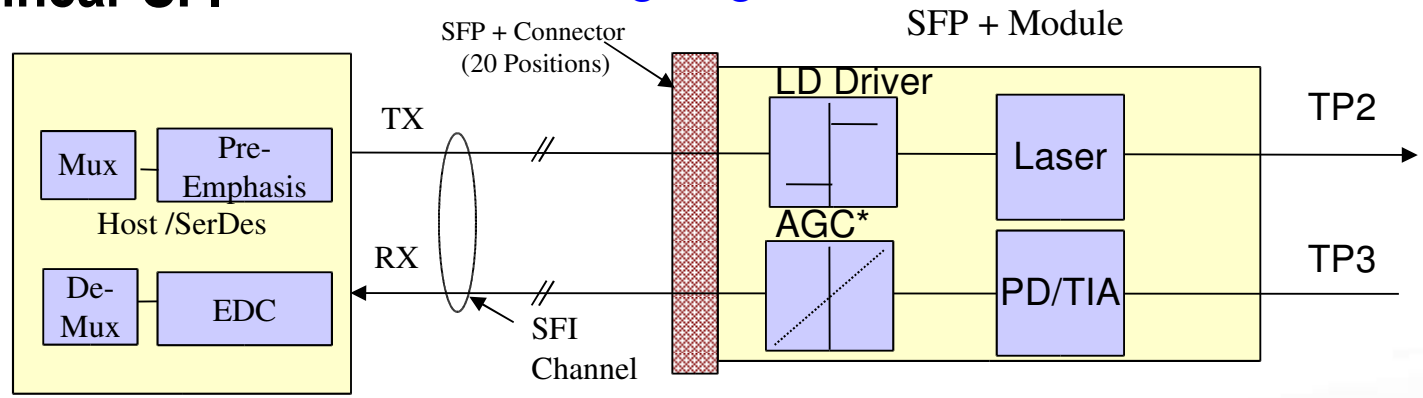


Block Digram Limiting and Linear SFI

- **Limiting SFI**



- **Linear SFI**



* Common implementation incorporates AGC in to the PD/TIA

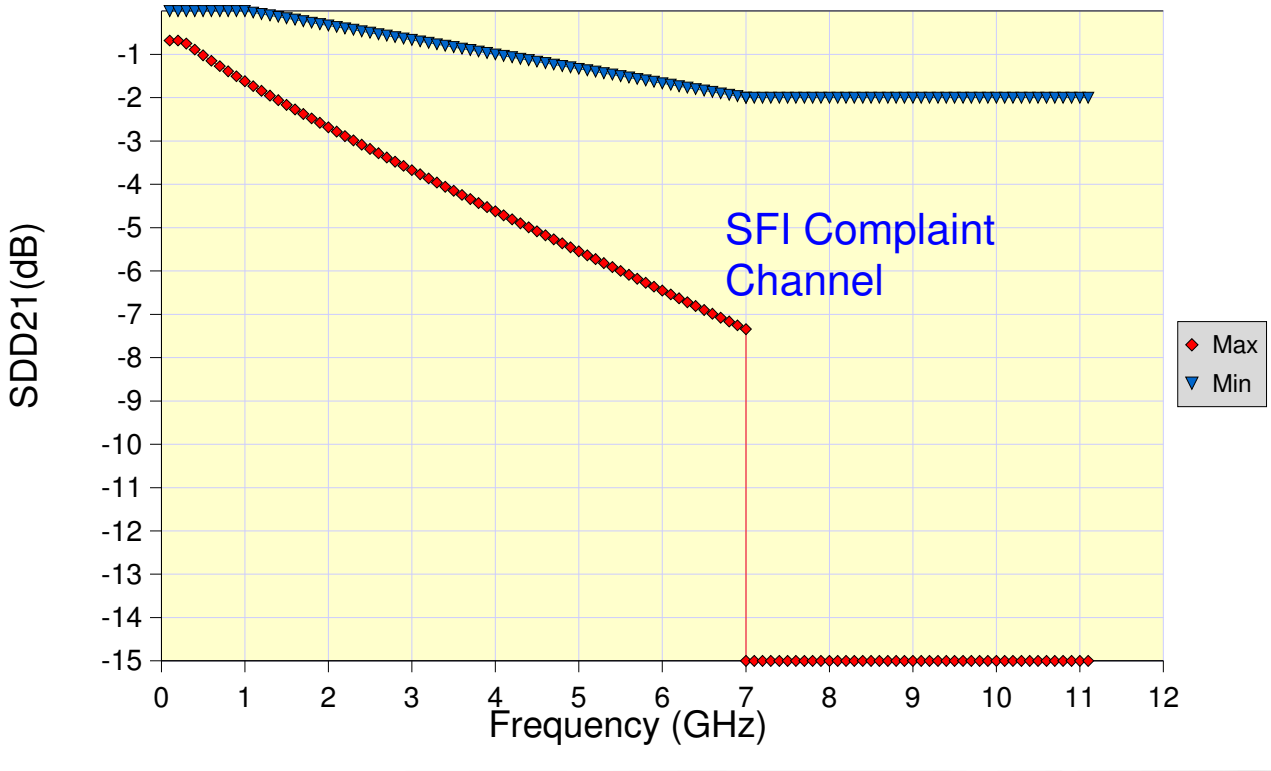
Difference Between XFI and SFI Specifications

- **XFI specifications allows only limiting optical**
- **SFI relies on the open loop transmit pre-emphasis, improved routing, and better transmitter to deliver 0.1 UI DDJ to the module.**
  - **SFI must deliver lower output TJ across the channel at B than XFI transmitter at A!**
  - **Assuming a 4x or 10x link can have the same performance is pre-mature.**

Standard	A	B	C	D	B'	C'	D
XFI DD (UI)	0.15		0.18			0.18	
XFI Non-EQJ (UI)		0.41			0.41		0.45
XFI TJ (UI)	0.3	0.61	0.3		0.61	0.34	0.65
SFI DDJ (UI)		0.1	0.42		0.1	0.42	
SFI TJ (UI)		0.28	0.7		0.28	0.7	

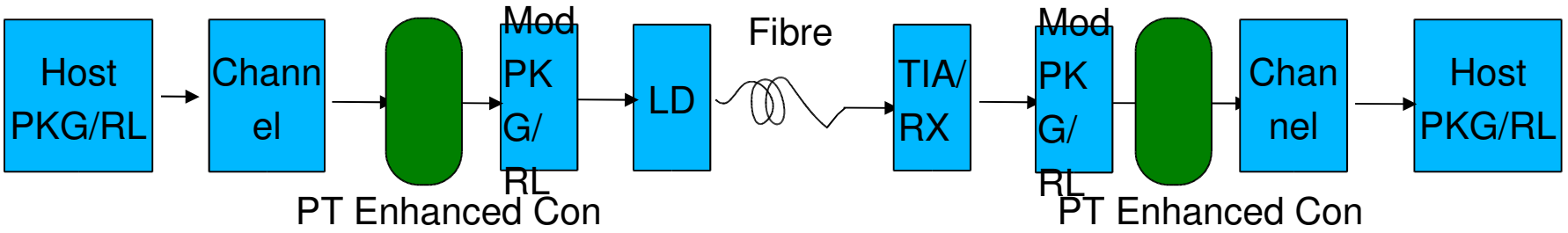
SFI Channel Requirements

- **Min loss is to limit multiple reflection induced jitter**



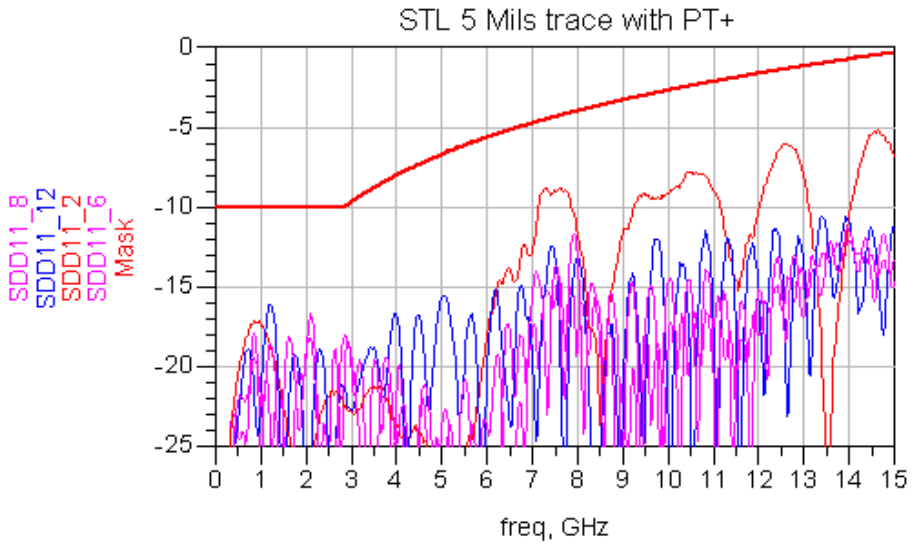
SFI Basic Link Model

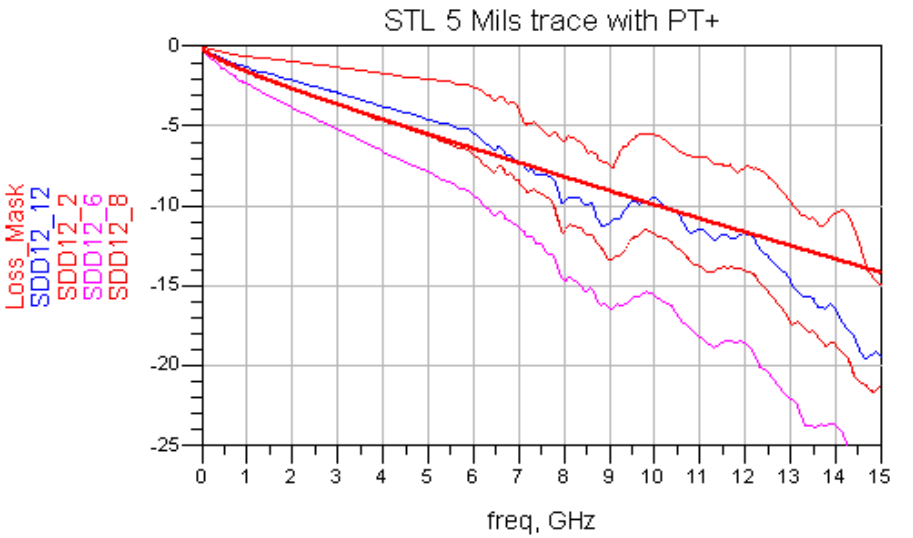
- **End to end modelling with limiting and linear elements**
  - **Leverage LRM fibre model with addition of the electrical channel**



Broadcom Stripline Board with PT Enhanced

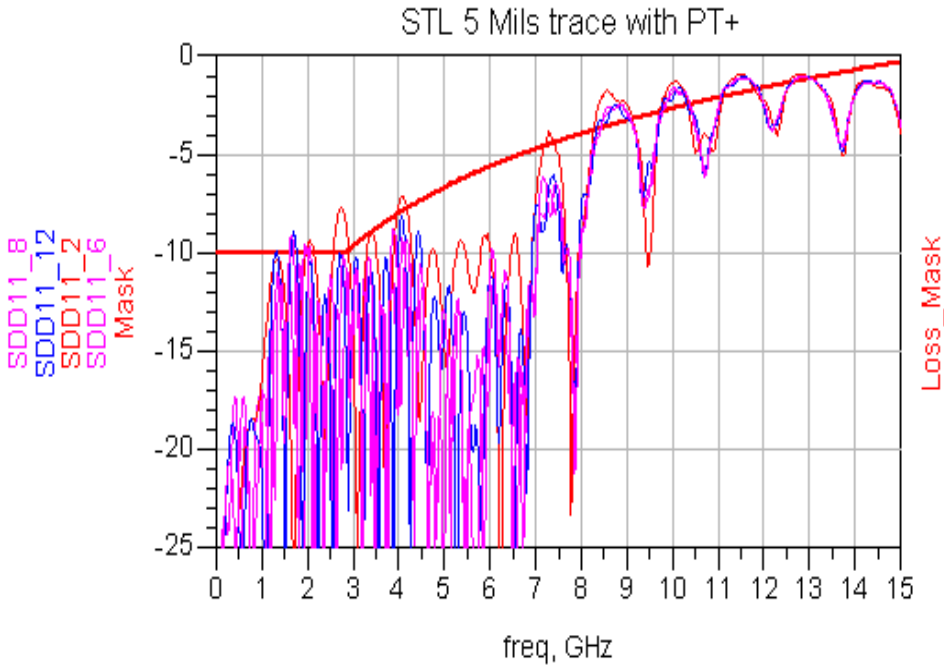
- **Based on Fr4-13 board with 5 mils for 2, 6, 8, and 12”**
  - **8” and 12” STL fail insertion loss limit**

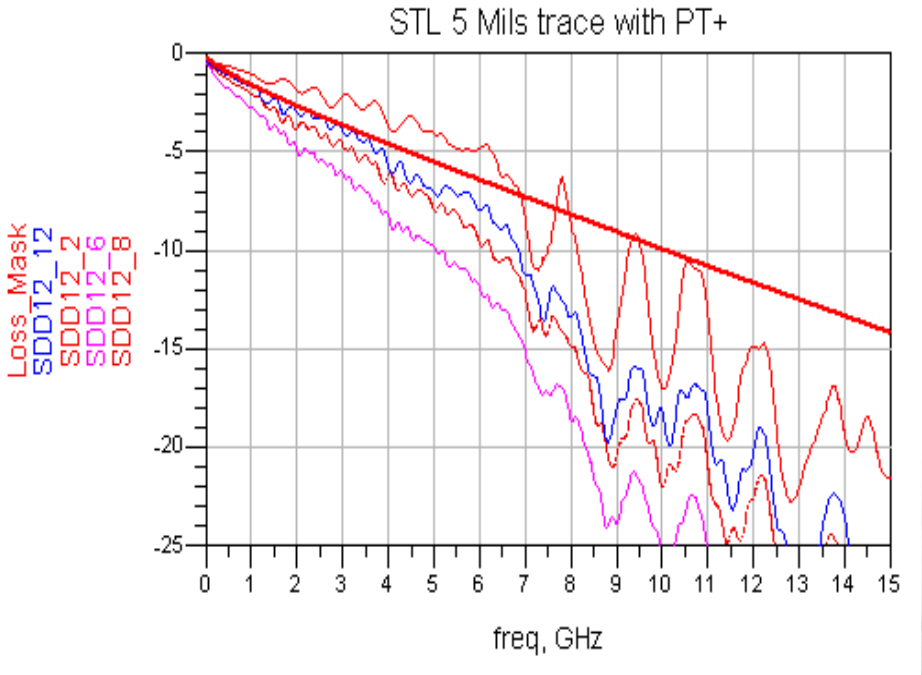




End to End Path Stripline

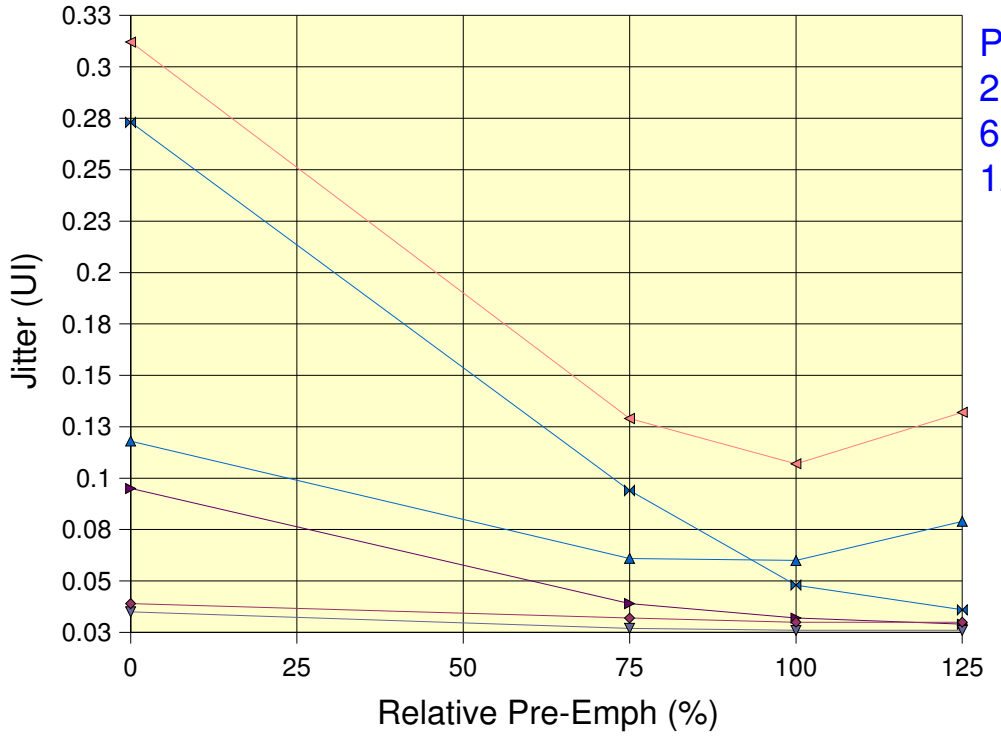
- **The mask are only for reference**
- **Ripple in the response makes TX pre-emphasis imprecise**





DDJ and PWS for Broadcom Stripline Channels

- 6 in is at the SFI loss limit
- Does not include SerDes device jitter

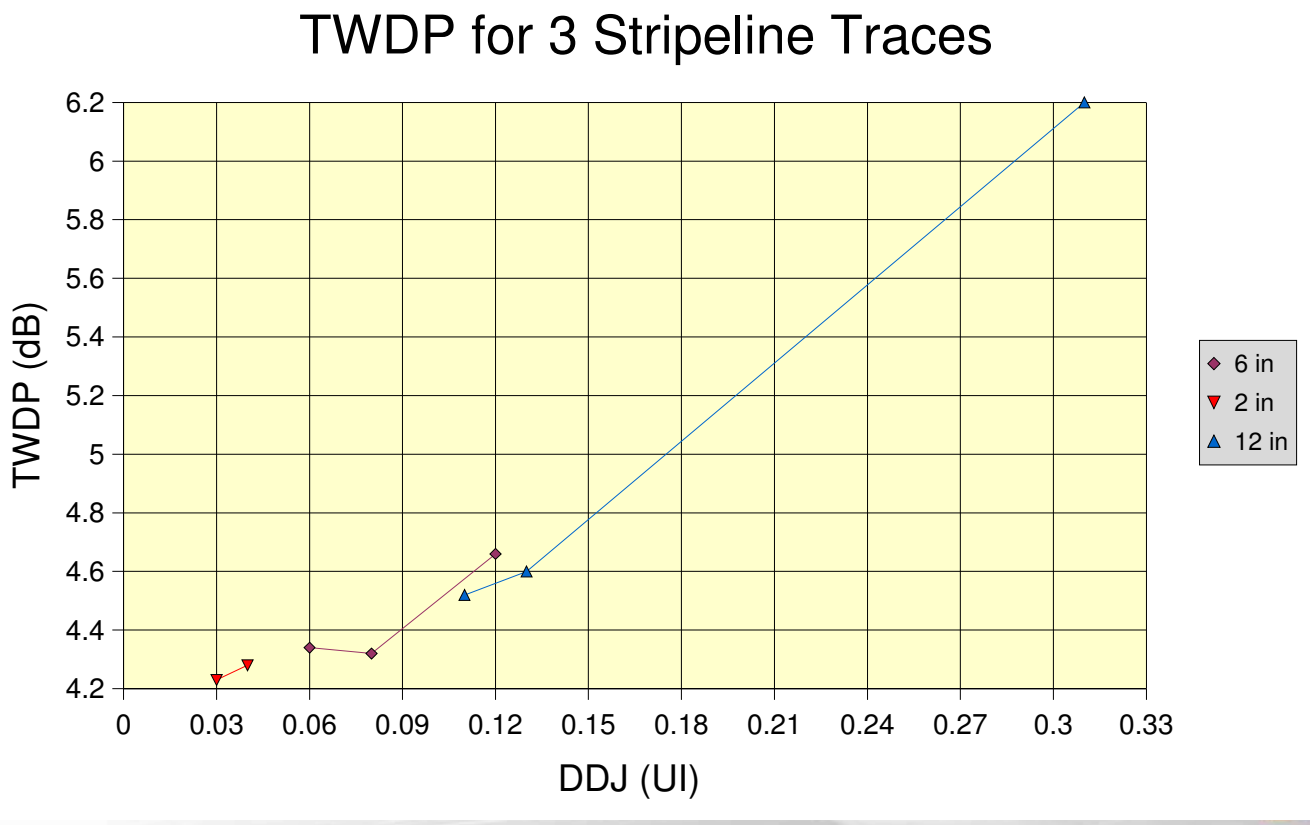


Pre-Emp Optimum Level 100%
2 in = 3 %
6 in = 11 %
12 in = 21 %

100% Relative Pre-emph = Optimum Pre-emphasis
0% Relative Pre-Emph = No Pre-emphasis

General Relationship of Input DDJ and the Output TWDP

- **Assumes a TANH soft limiter and BT4 filter to get 47 PS transmitter output rise time**



Additional Degradation to DDJ

- **SFI DDJ at B=0.1 UI**
  - **Propose DDJ at B for 4x link 0.15 UI**
  - **Propose DDJ at B for 10x link 0.18 UI**
- **Can the optical link be closed with 0.18 UI of input DDJ and max TJ at C' of 0.6 UI?**

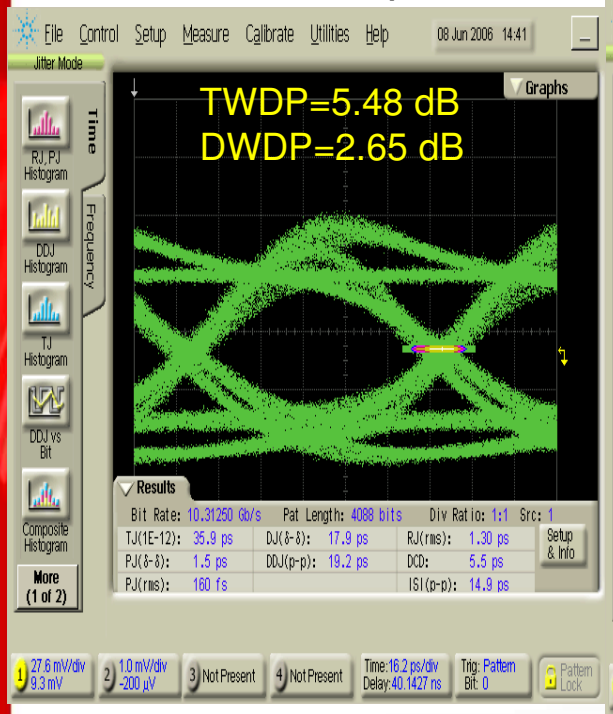
Degradation	4x Jitter (UI)	10x (UI)
SFI B	0.1	0.1
SerDes Penalty	0.03	0.05
PCB Routing	0.02	0.03
Total DDJ B	0.15	0.18

Degradation	4x Jitter (UI)	10x (UI)
SFI C'	0.7	0.7
SerDes Penalty	-0.04	-0.07
PCB Routing	-0.02	-0.03
TJ at C'	0.64	0.6

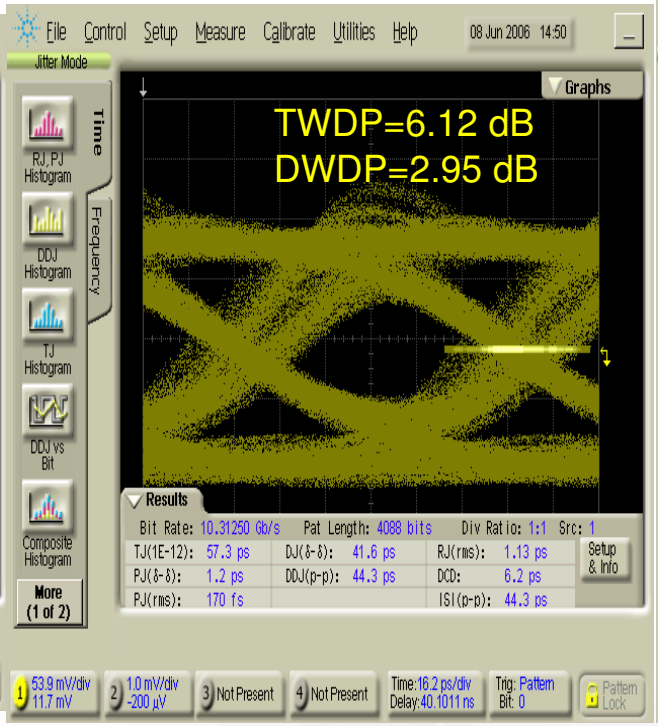
Typical TWDP/DWDP for 4 Gig Lasers

- **Commercially shipping module from 3 suppliers**

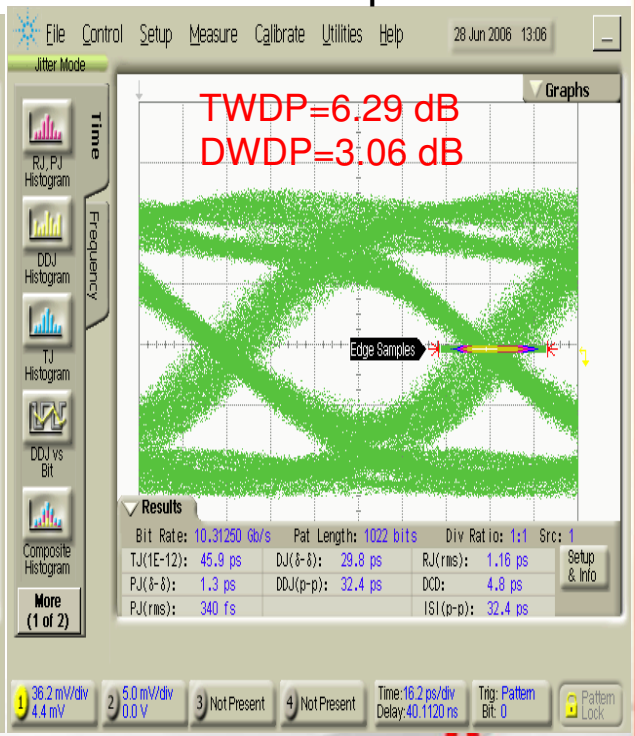
SFP PT Enhanced 2”
TJ=36.9 ps



SFP PT Enhanced 2”
TJ=57.3 ps

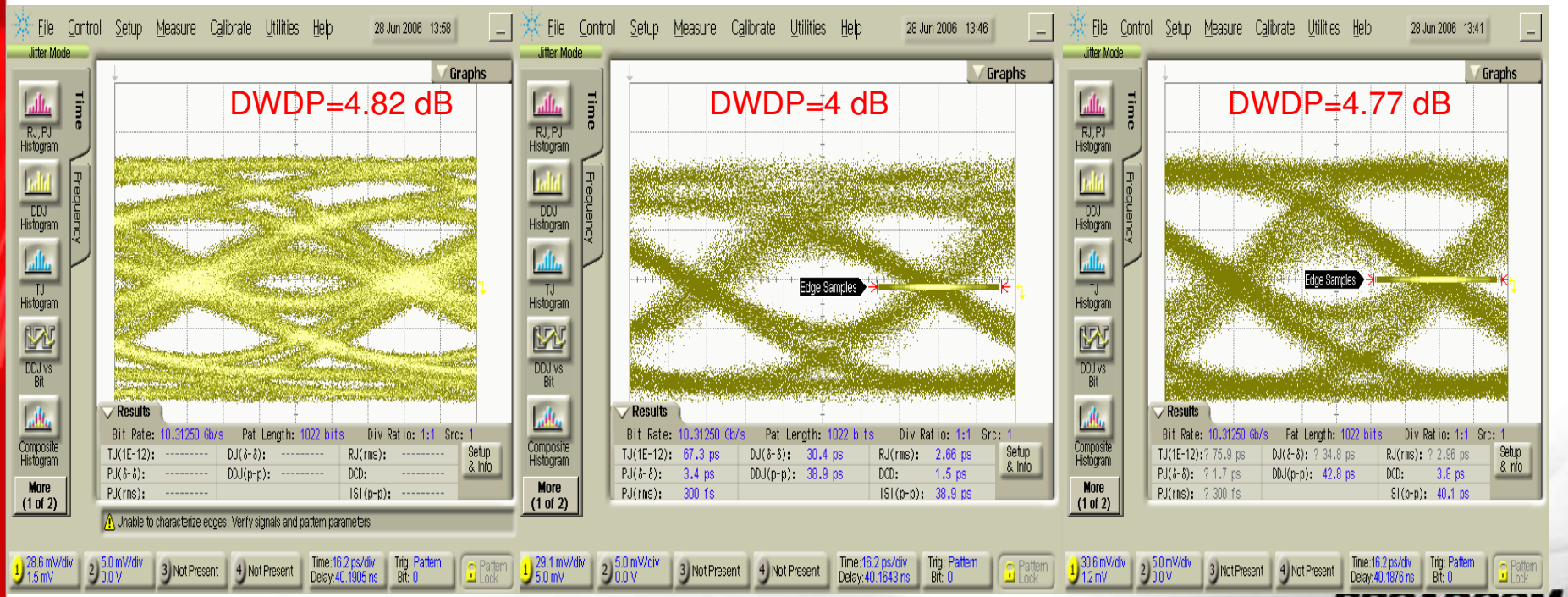


SFP PT Enhanced 2”
TJ=46 ps



Typical Receive Eye

- **All laser operated error free with LRM like EDC over typical 300 m OM3 fiber.**



Conclusion

- SFI jitter specifications is very challenging and would be very difficult to scale to 4x and 10x limiting link.
  - Reducing optical dispersion / reach will help the limiting interface the link may not be manufacturable due to tight jitter budget.
- Use of linear interface with EDC can allow
  - Relaxing SerDes transmitter
  - Relaxing SerDes receiver
  - Allowing more margin for the host implementations
  - Common electrical interface for 4x and 10x
  - Use lower cost optics.
- EDC is becoming an standard feature just as pre-emphasis has already become on the 10G SerDes.
- Linear Interface can directly support up to 10m copper.

BROADCOM
Connecting everything