Analysis of Next Generation FC Disk Drive Interface

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FCIA Meeting

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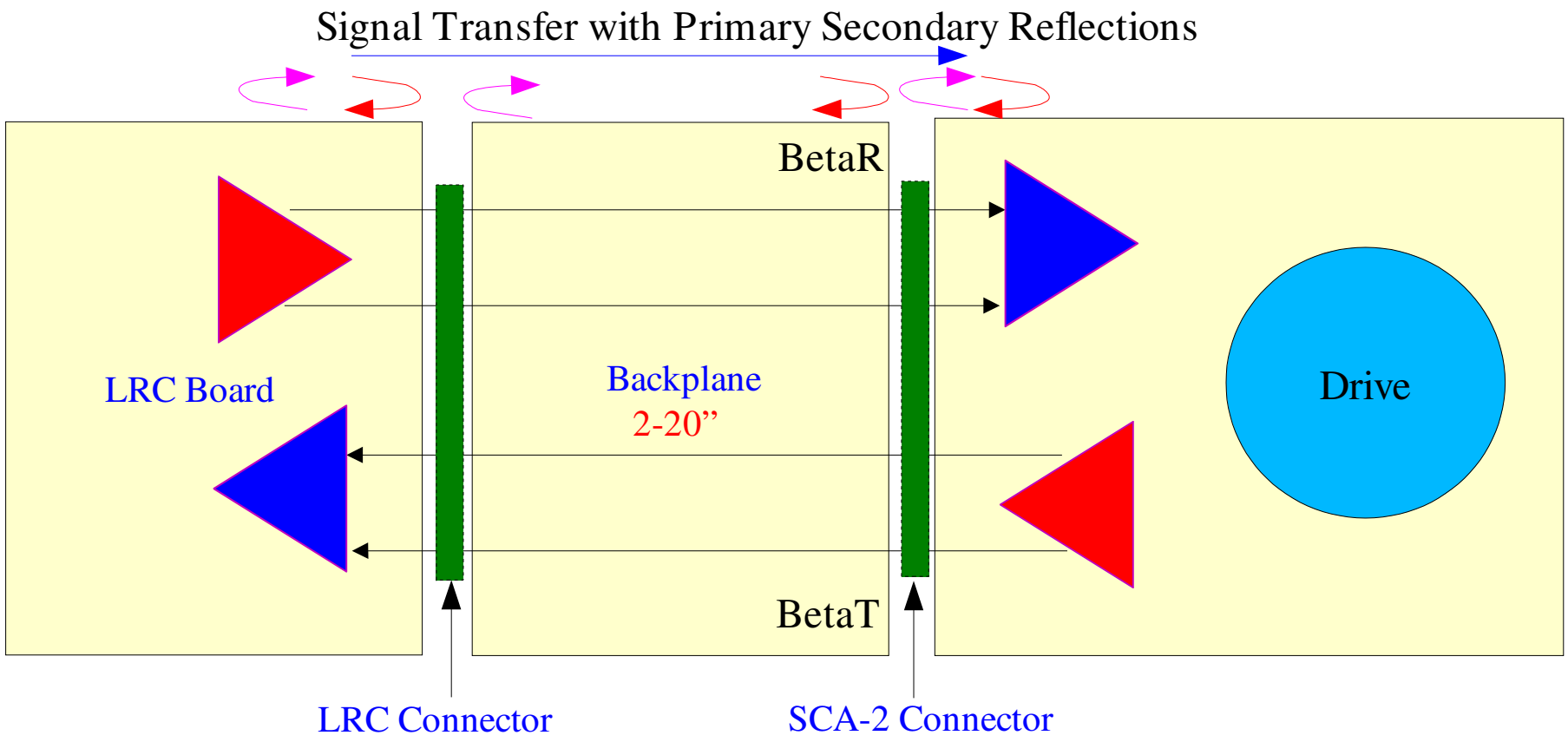
Overview

- Limitaions
- FC disk array architecture
- SCA-2 Simulations and Measurements
- Comparison of 8B/10B at 8.5 Gb/s vs 64/66B at 10.51 Gb/s.

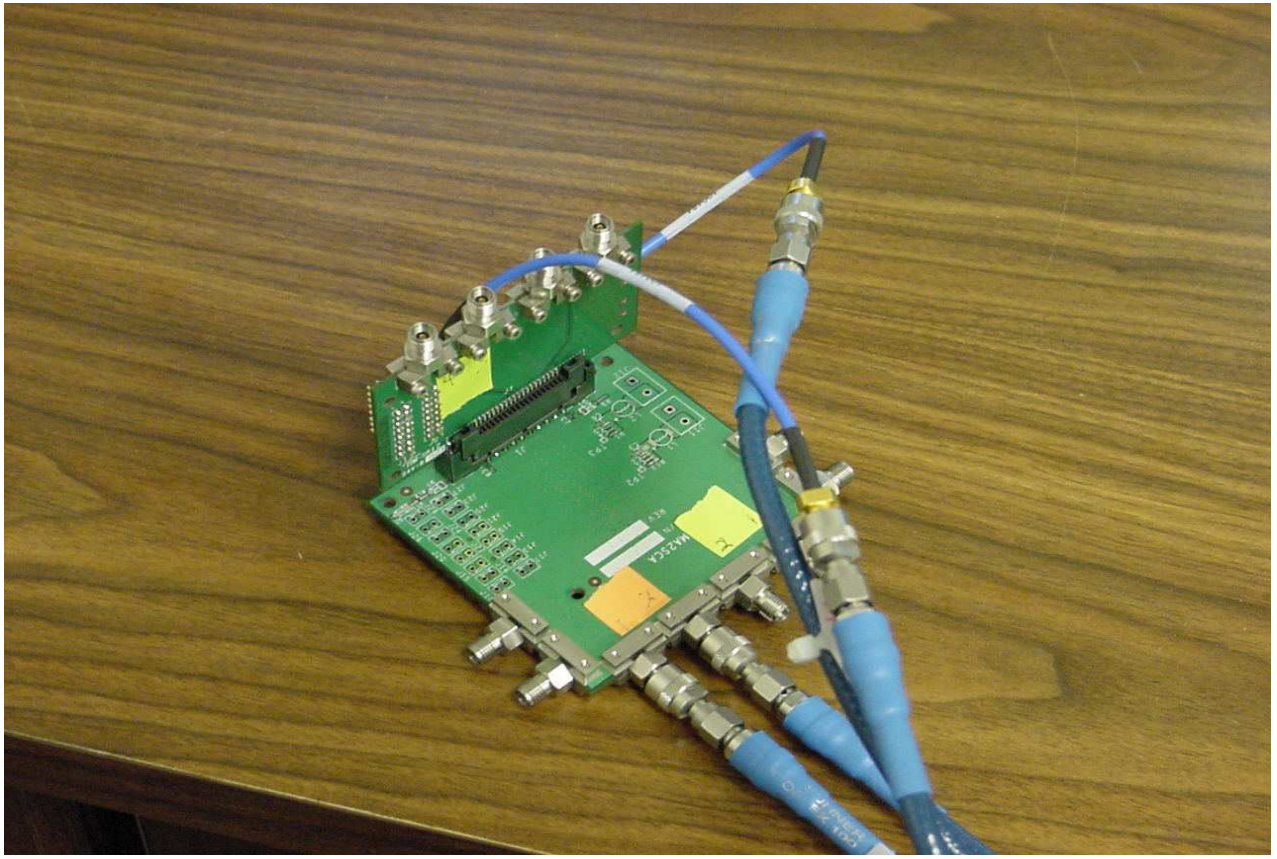
Limitaion in Operating Disk Interface Faster

- Multiple reflection will be the most complex degradation mechanism
  - ⇨Connector and driver multiple reflection can be catastrophic
- ISI from a typical FR-4 backplane will close eye
  - ⇨At 2 Gb/s FC link often operated with no pre-emphasis
  - ⇨At 4 Gb/s carefully set single pre-emphasis can work
  - ⇨At 8.5 Gb/s open loop pre-emphasis is not practical no longer and receive equalization would be needed.
- SCA-2 Connector limitations is the focus of this presentation.

FC Disk Interconnect Architecture

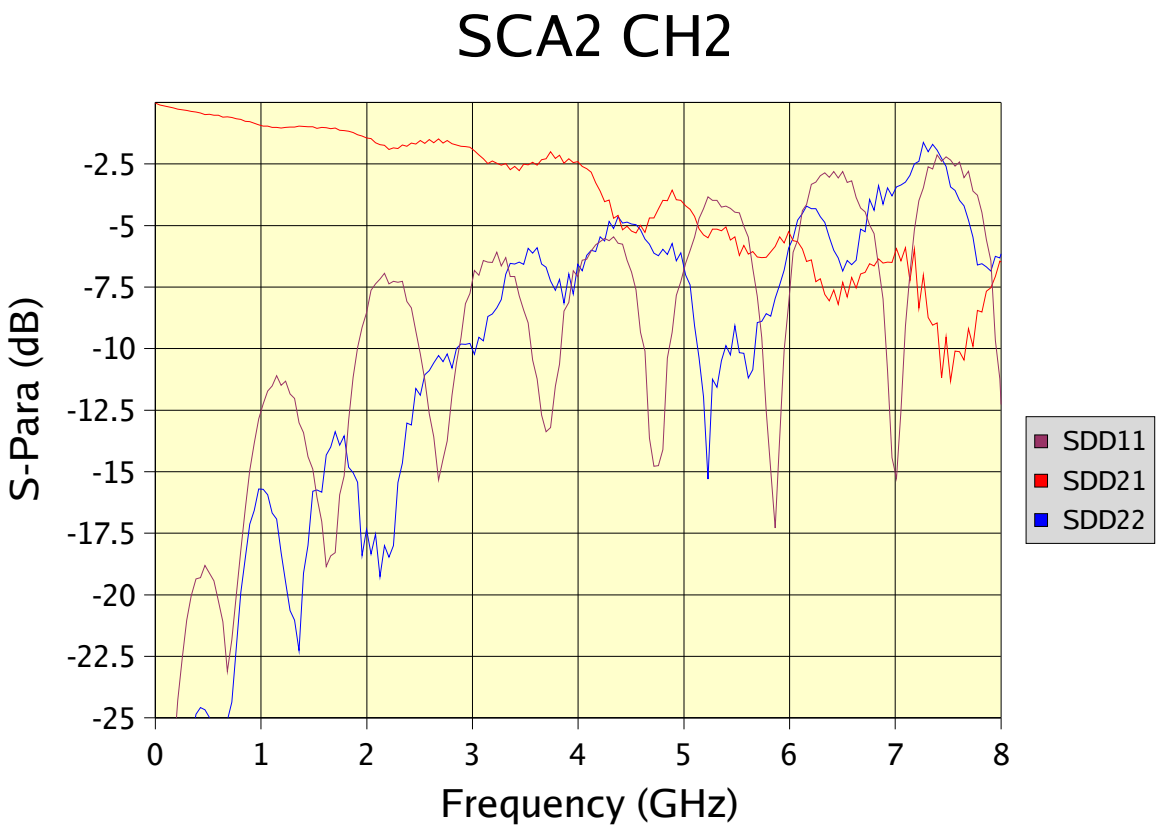


SCA-2 Measurement Board



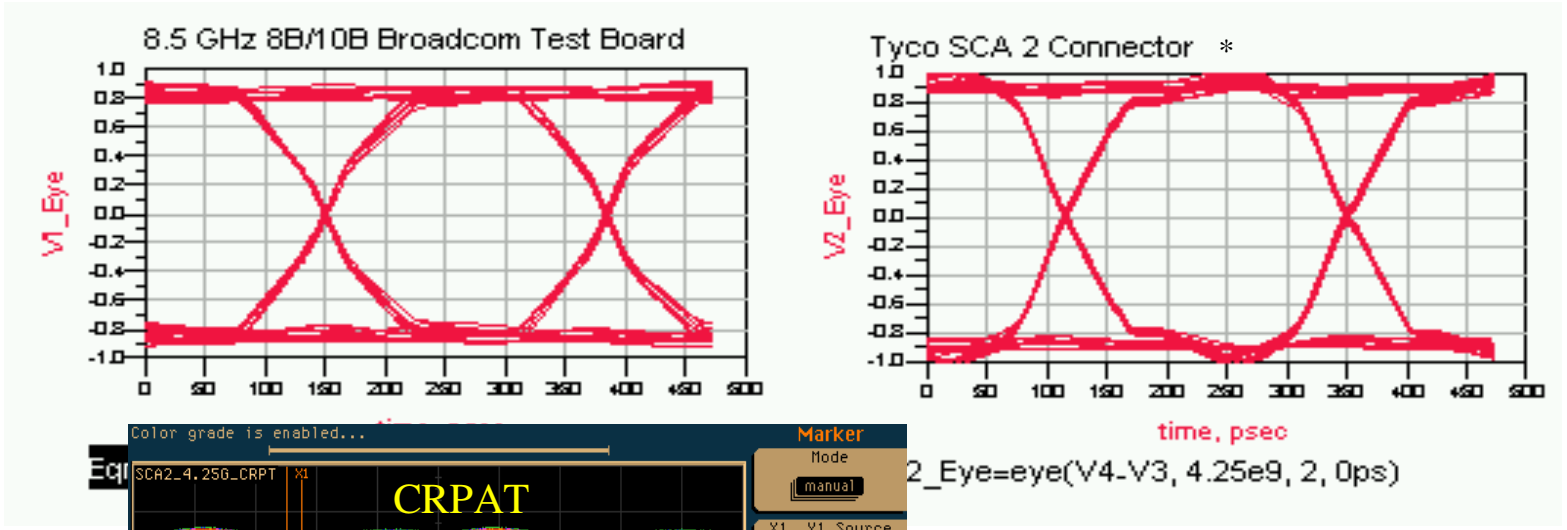
Performance of SCA-2 Board

- **Connector goes through resonance at 4.5 GHz.**
  - ⇨ SDD11 can be improved further.



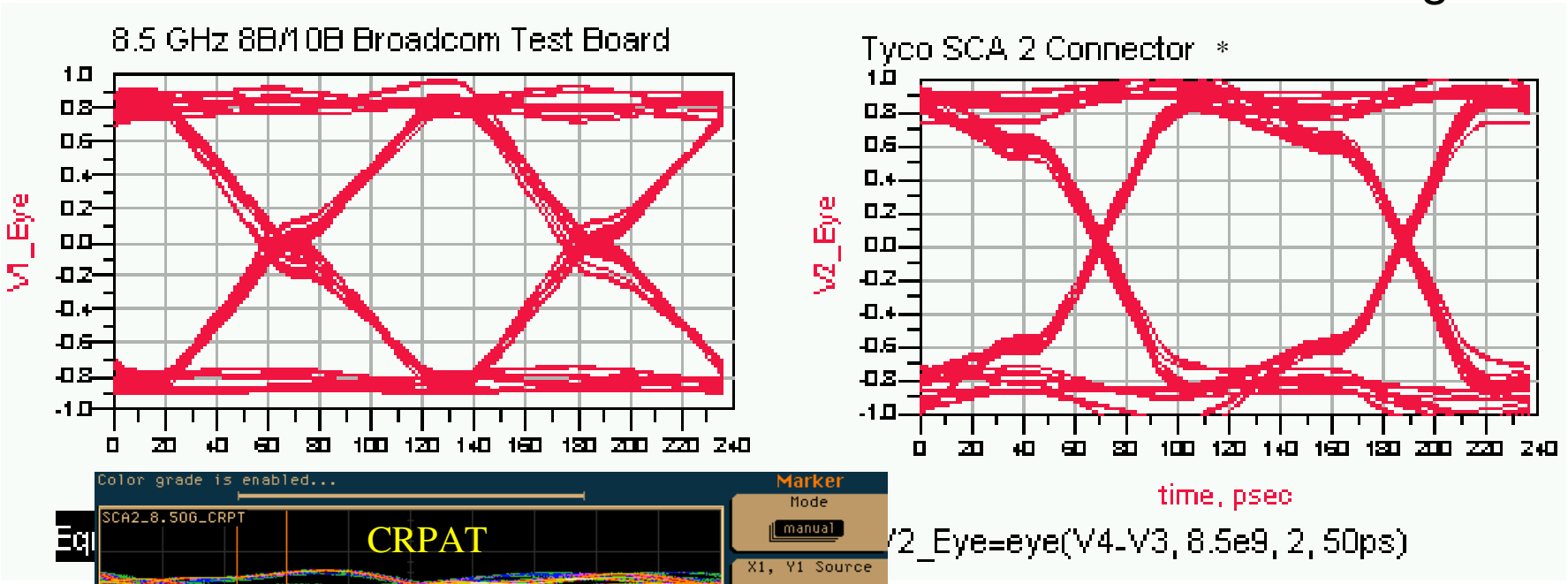
SCA-2 Simulation at 4.25Gb/s

- **Excellent correlation between measurement and simulation**



SCA-2 Simulation at 8.5 Gb/s

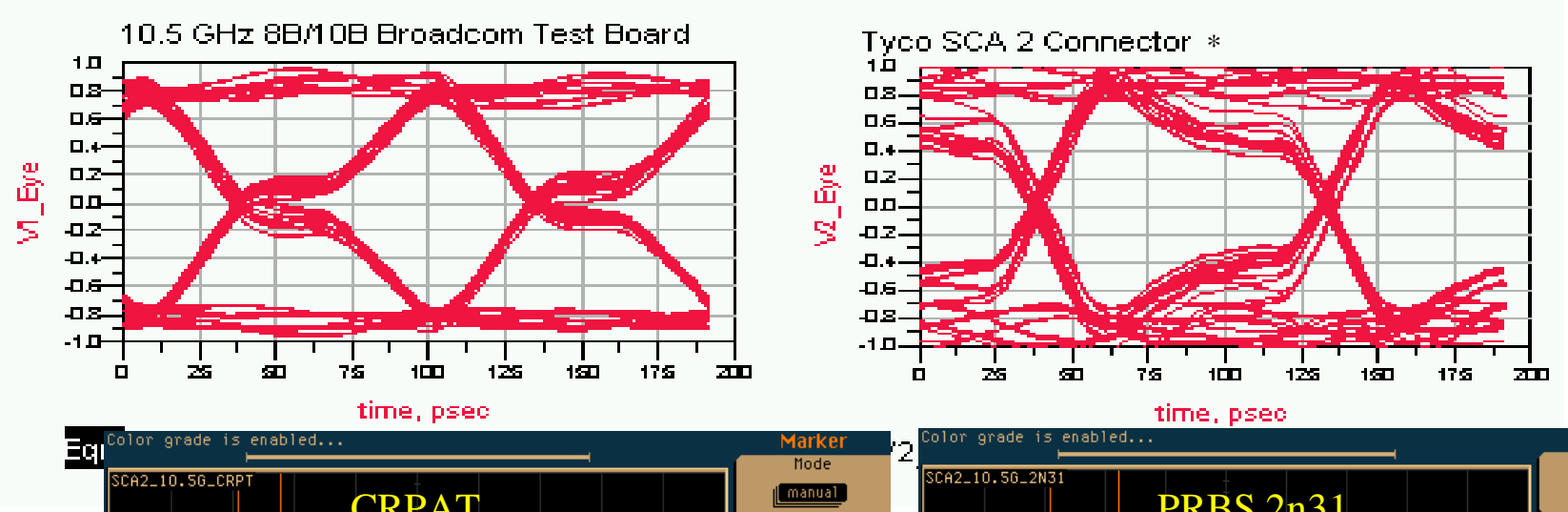
- Reasonable simulation to measurement correlation at 8.5 Gig.



* Model Provided Courtesy of Tyco Electronics

SCA-2 Measurement & Simulation at 10.5 Gig

- Discrepancy's between measurement and model increases.



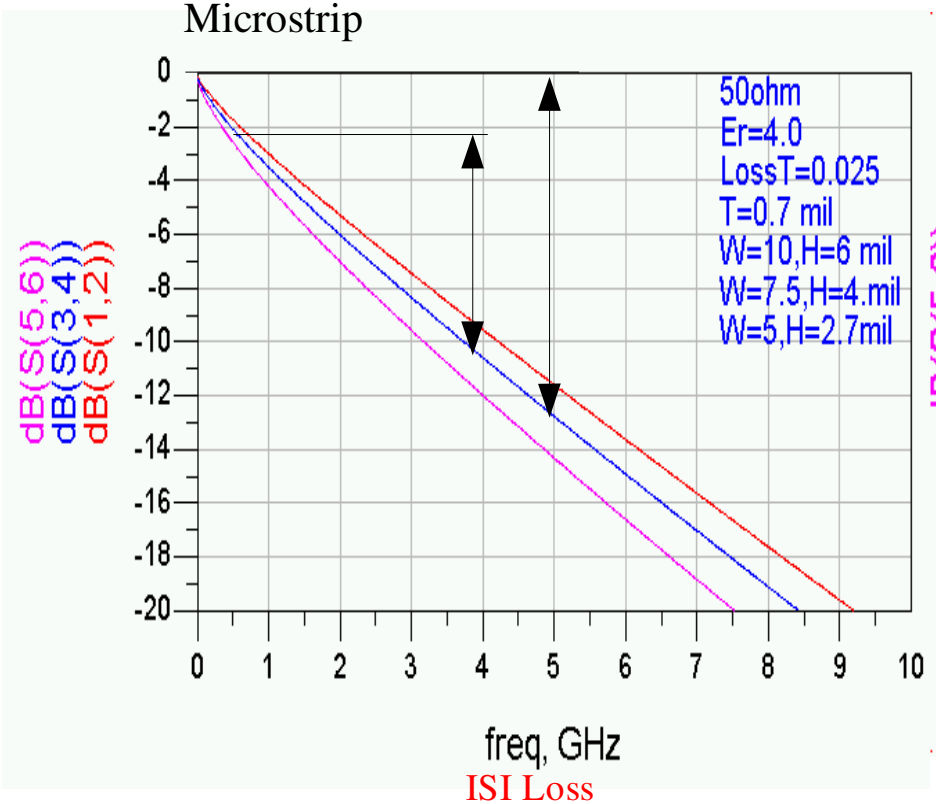
- *Jitter RMS increases 48% for PRBS 2n31 vs CRPAT!*

* SCA-2 Model Provided Courtesy of Tyco Electronics

20” Long FR4 Loss

- Current 4GFC link has 5.6 dB of ISI budget.

Microstrip

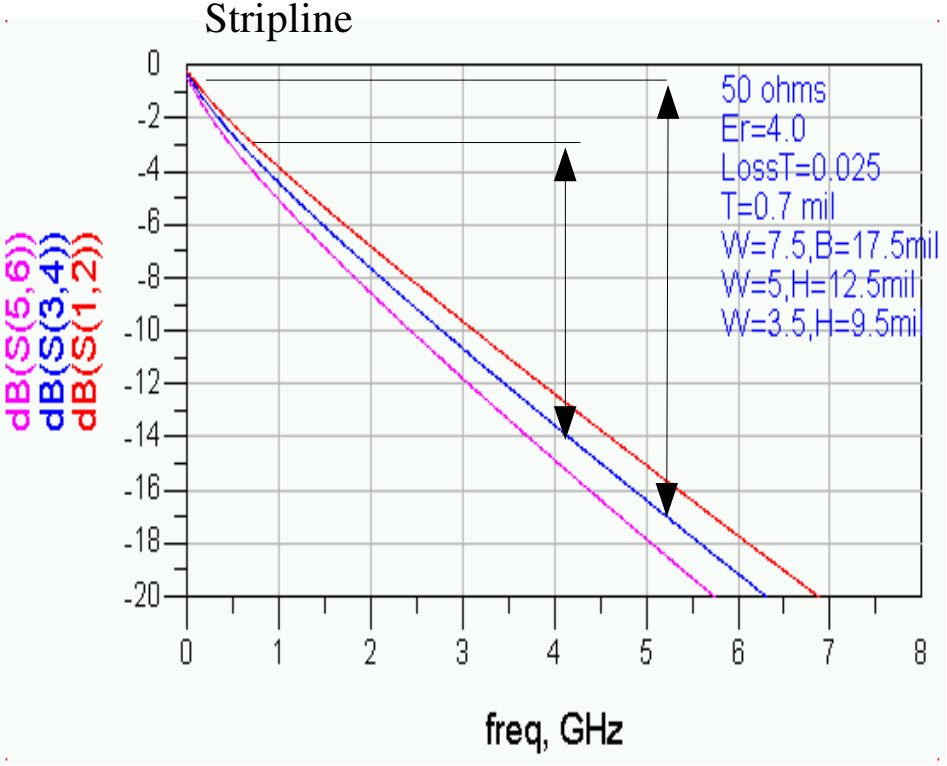


ISI Loss

8.5 Gig 8B10B ~ 8 dB

10.51 Gig 64/66B ~ 13 dB

Stripline

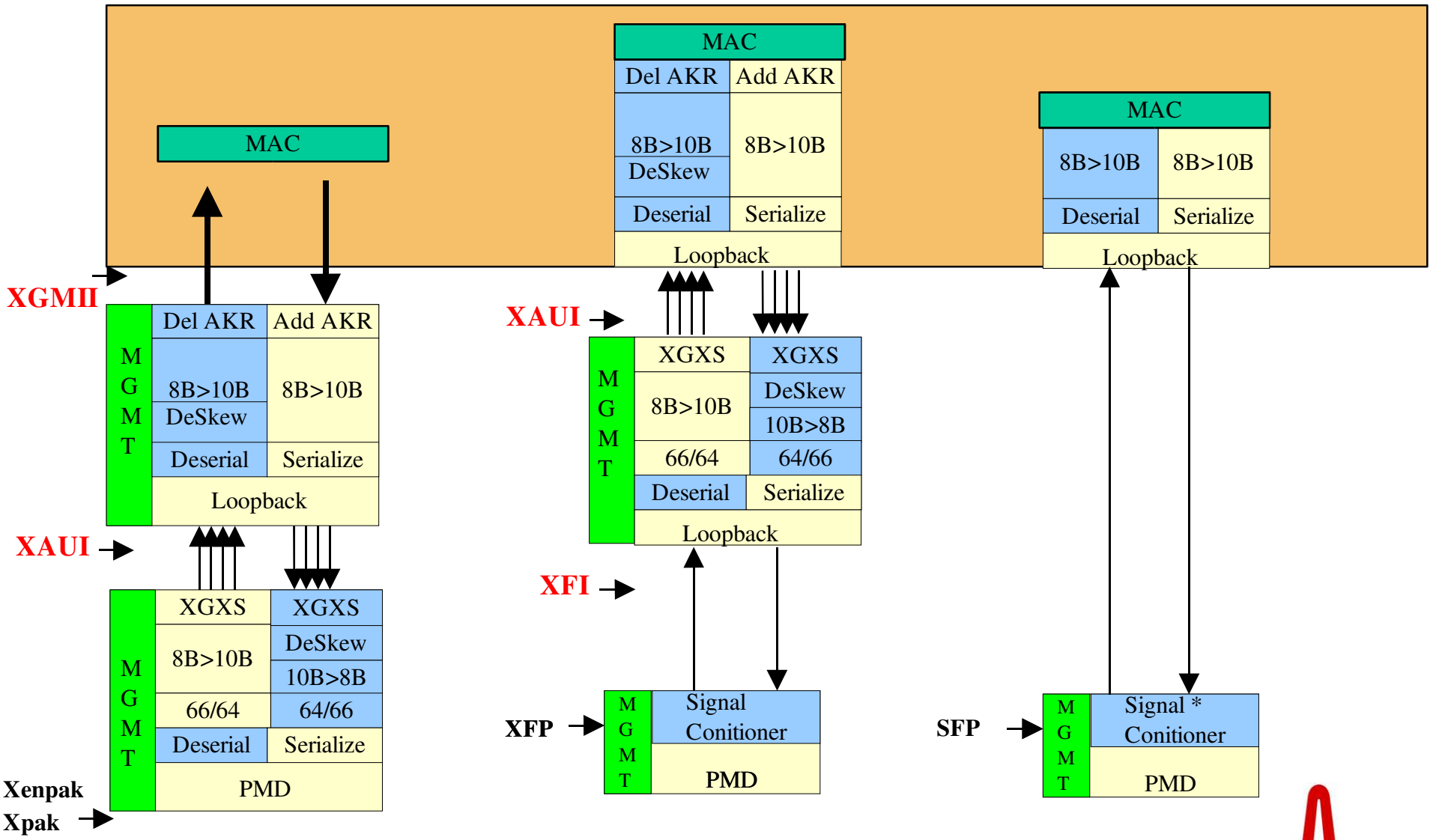


ISI Loss

8.5 Gig 8B10B ~ 11 dB

10.51 Gig 64/66B ~ 16 dB

10GFC and 8.5 GFC MAC Interface



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Comparison of 8B/10B vs 64/66B

Parameter	8B/10B @ 8.5 Gb/s	64/66B @ 10.51 Gb/s
Transfer Rate	800 MByte/s	1275 MByte/s
Overhead	20.00%	3.00%
Encoder+Decoder Latency	~6 ns	~80*
Run Length	5	Statistically ~ 2n31
Low Frequency Cutoff	~ 8.5 MHz	~ 100 KHz
Backplane ISI Penalty 20” FR4	9.5 dB	14.5 dB
Backplane ISI Increase from 4 GFC	70.00%	258.00%
Connector Vertical Eye Opening	75.00%	50.00%
Connector Horizontal Eye Open	98 ps	71 ps
* Total latency through a 2 Gig Disk drive today is 6 FC word or ~100 ns!		

Summary

- SCA-2 connector was demonstrated to operate at 8.5 Gb/s.
  - ⇨ Additional improvement by Tyco is possible.
  - ⇨ Operating the connector at 10.51 Gb/s require significant improvement.
- Operating at 10.51 Gb/s with 64/66B vs 8B/10B at 8.5 Gb/s is significantly more challenging.
  - ⇨ The draw back of 8B/10B is the Idle EMI and can be improved with Arbff or going to scrambled Idle.
- Ease of backward compatibility, low cost, and low latency are detrimental for next generation FC disk drives.