
HSSG Copper Objectives

Prepared by:

Participants of the HSSG copper interest list

Presenter: Chris Di Minico

HSSG copper interest list

- **Michael J. Bennett,** **LBLnet Services Group**
- **Yakov Belopolsky,** **Bel Stewart Connector**
- **Ed Cady,** **Meritec**
- **Larry Cohen,** **Independent**
- **Chris DiMinico,** **MC Communications**
- **Alan Flatman,** **Independent**
- **Henning Hansen,** **Leoni High Speed Cables**
- **Sanjay Kasturia,** **Teranetics**
- **Greg McSorley,** **Amphenol Interconnect Products**
- **Ron Nordin,** **Panduit Corporation**
- **Joe O'brien,** **Efficere Technologies**
- **Gourgen Oganessyan,** **Molex Incorporated**
- **Joe Pein,** **Honda Connector**
- **Petre Popescu,** **Astar**
- **Bob Thornton,** **Fujitsu Components America, Inc.**
- **Herb Van Deusen,** **W.L. Gore**
- **George Zimmerman,** **Solarflare Communications**

Supporters:

- Schelto Vandoorn Intel
- Ali Ghiasi Broadcom
- Dan Dove Dove Networking Solutions –
ProCurve Networking by HP
- Shimon Muller Sun Microsystems
- Olindo Savi Siemon Company
- Joel Goergen Force10 Networks
- Hugh Barrass Cisco
- David Law 3Com

Higher Speed Study Group Meeting Presentations:

November 14-16, 2006

- Feasibility of a 100 Gbps copper interconnect

12-Nov-06 Chris DiMinico, MC Communications, George Zimmerman,
Solarflare Communications

January 17-19, 2007

- Market Potential for 100 GbE Copper

11-Jan-07 Chris Di Minico, MC Communications

- March 12-15, 2007

- The need for a low-cost 100GbE inter-rack copper interconnect

9-Mar-07 Mike Bennett LBNL

- 24 AWG twinaxial cable structure for 25Gb applications

9-Mar-07 Carl Booth, Amphenol Spectra Strip

Higher Speed Study Group Meeting Presentations

- [100G Copper Proposal: Technical Feasibility From Connector Technology Standpoint](#)

9-Mar-07 Gourgen Oganessyan, Jim McGrath, Molex

- [High Speed Copper Cabling for HSSG](#)

9-Mar-07 Herb Van Deusen Gore Associates

- [100G Ethernet Test Adapter](#)

9-Mar-07 Will Miller, Efficere Technologies

- [Twinaxial cable assembly transmission characteristics](#)

9-Mar-07 Chris Di Minico, MC Communications, George Zimmerman
Solarflare Communications

- [High Speed Study Group objectives and five criteria](#)

9-Mar-07 Copper interest group

Presentation objectives and non-objective

- **Identify HSSG copper objectives**
- **Technical and economic feasibility of 10 Gb/s serial operation**
- **Copper interconnects for >10 Gb/s**
- **Non objective – choosing a solution**

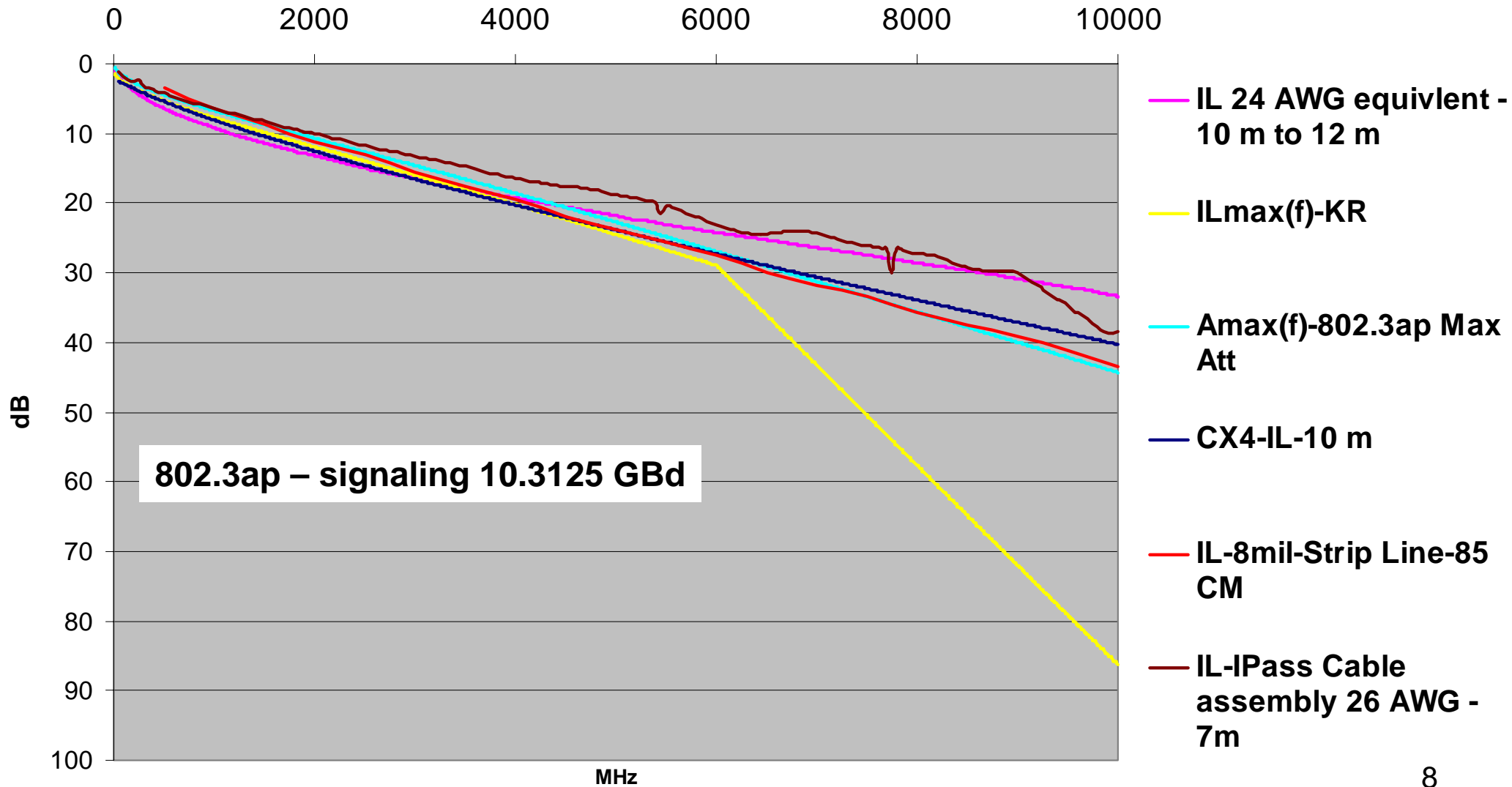
HSSG copper- Lane rate(s)-for discussion

serial lane rate Gb/s	Length (m) Passive cable	cable available	connector technology available
10	up to > 10	Yes	Yes
20	up to > 10	Yes	Yes
25	up to > 10	Yes	Yes

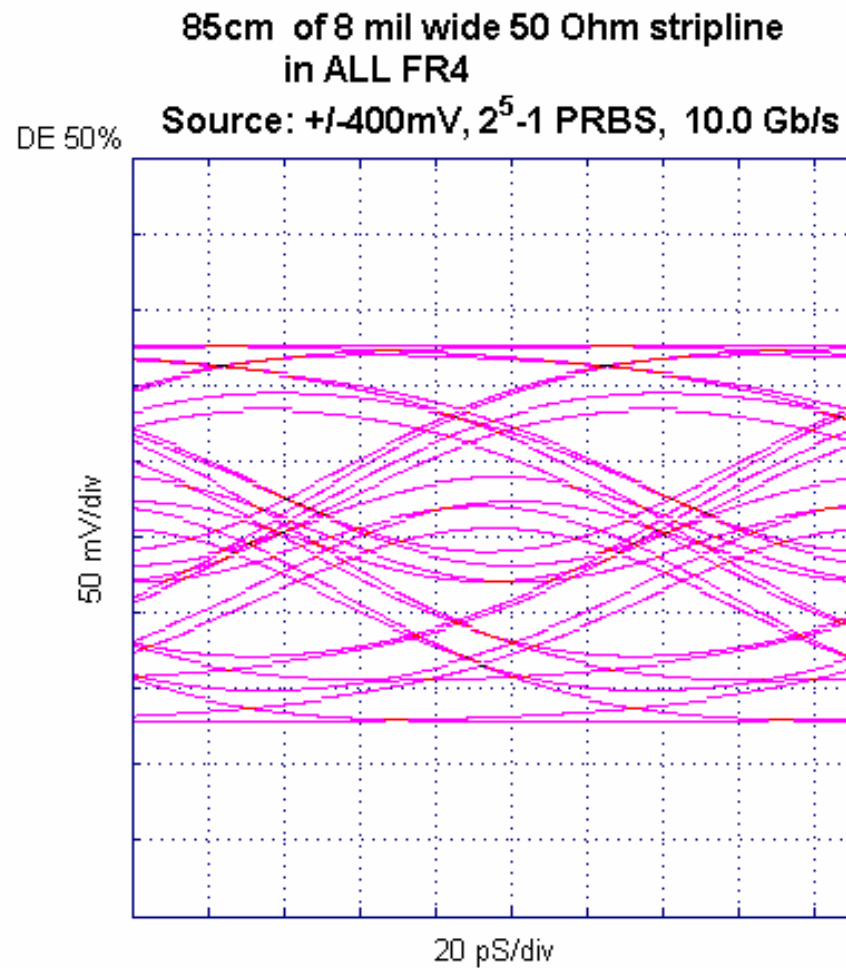
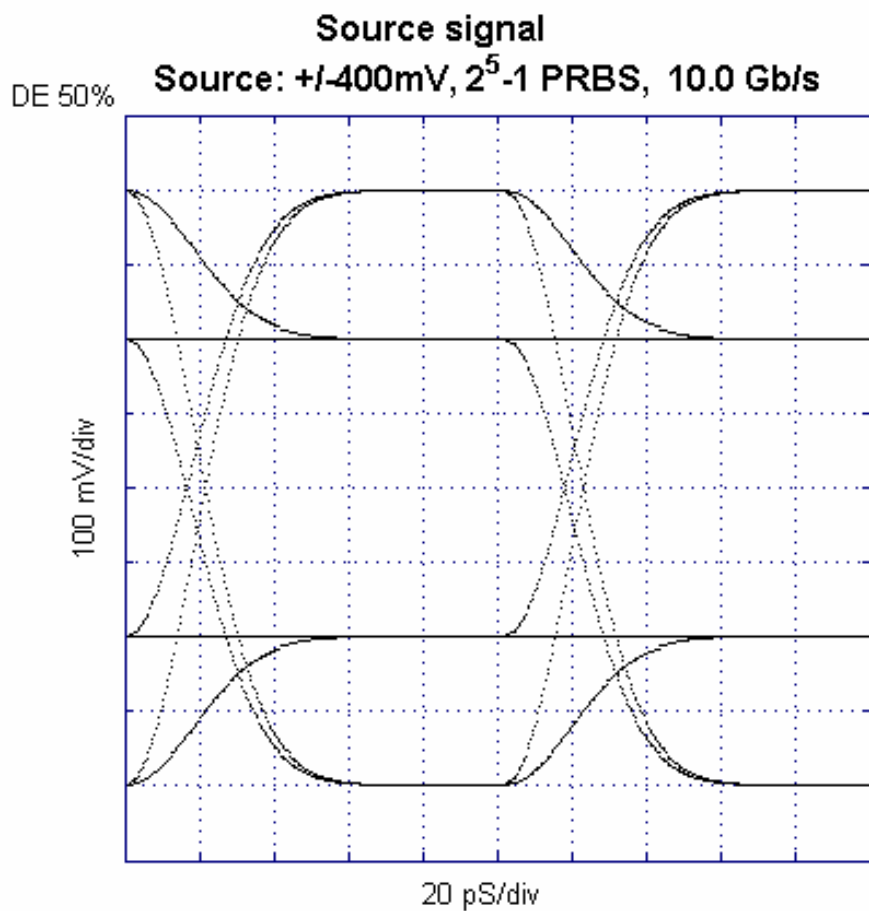
- Please note these rates are offered for discussion based on input from the call for interest list group. They are not to be considered as recommendations to the HSSG.

802.3ap - Ethernet Operation over Electrical Backplanes

802.3 ap Insertion Loss vs twinaxial cable assembly IL

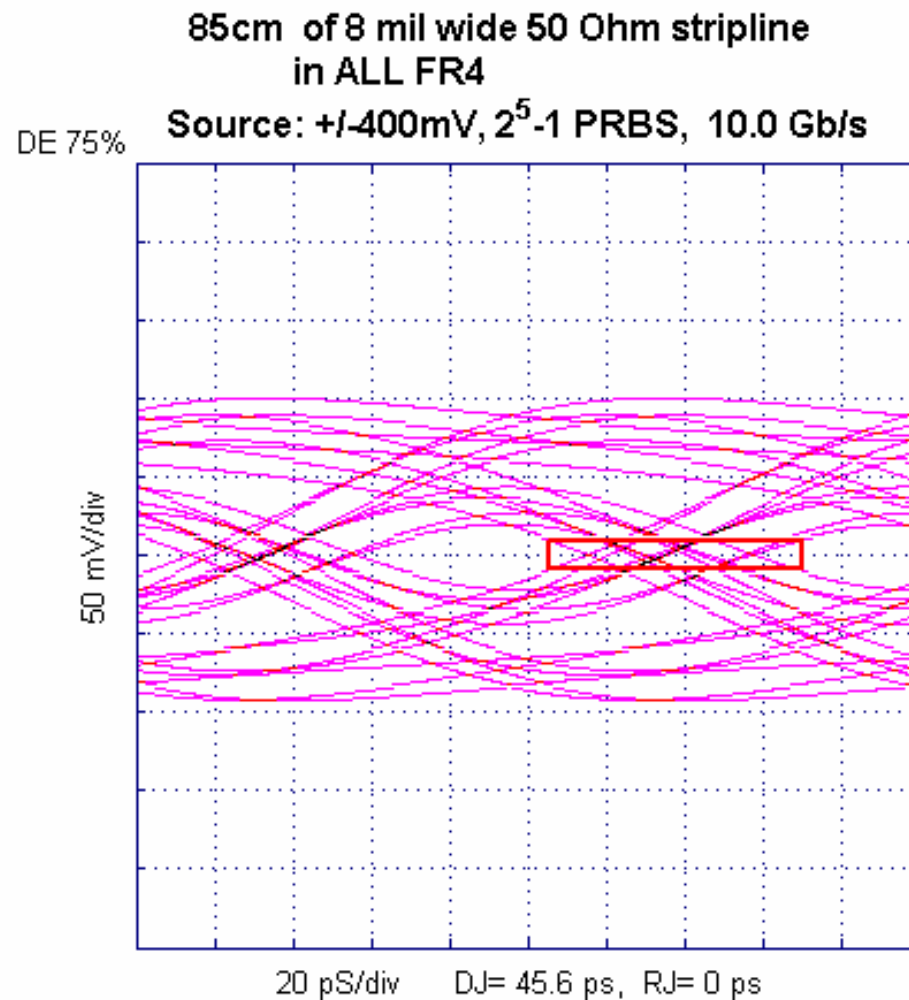
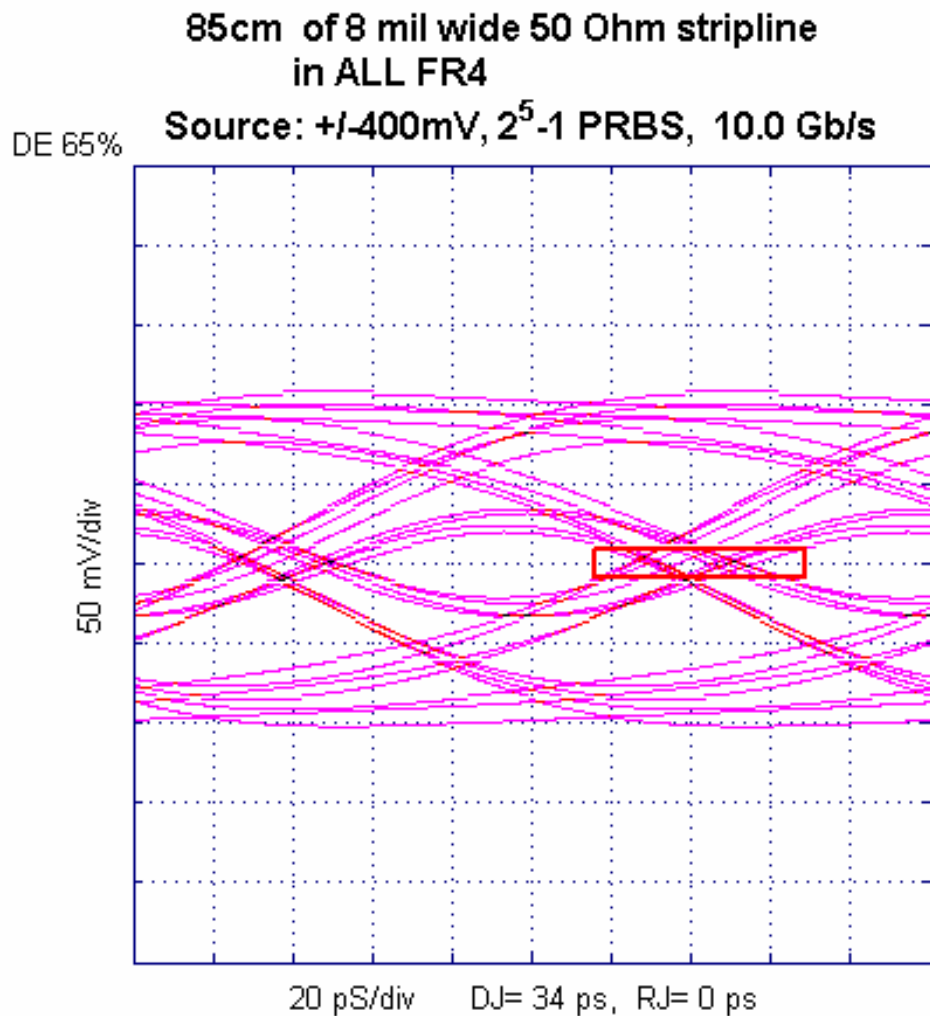


Eye patterns for FR4 transfer function



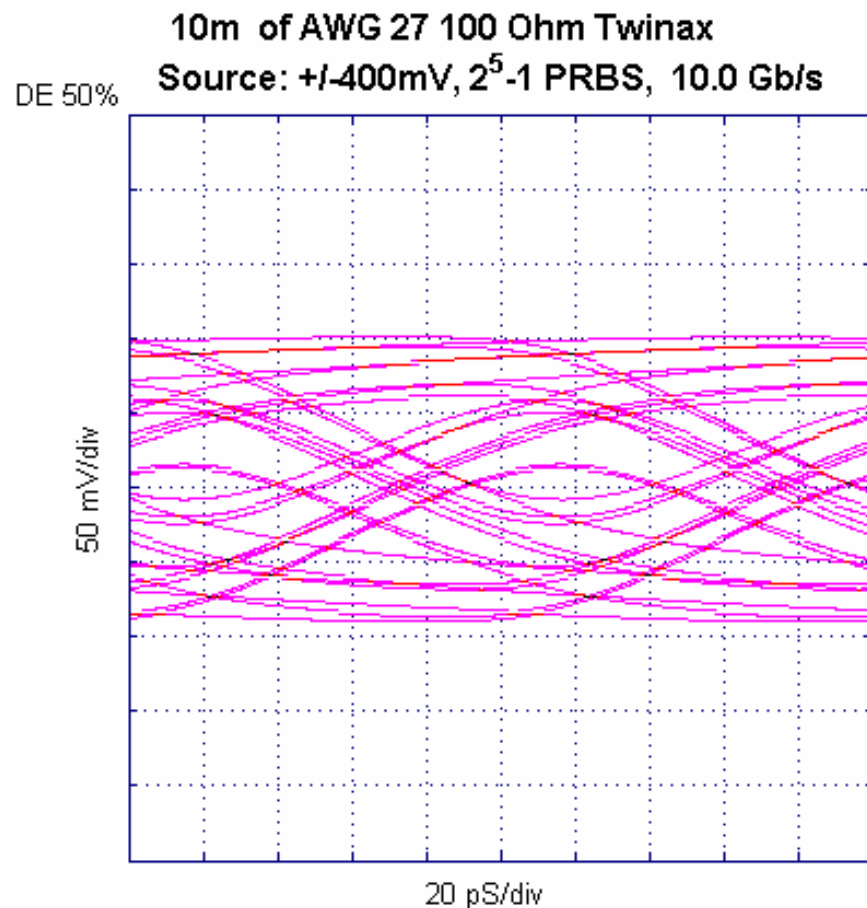
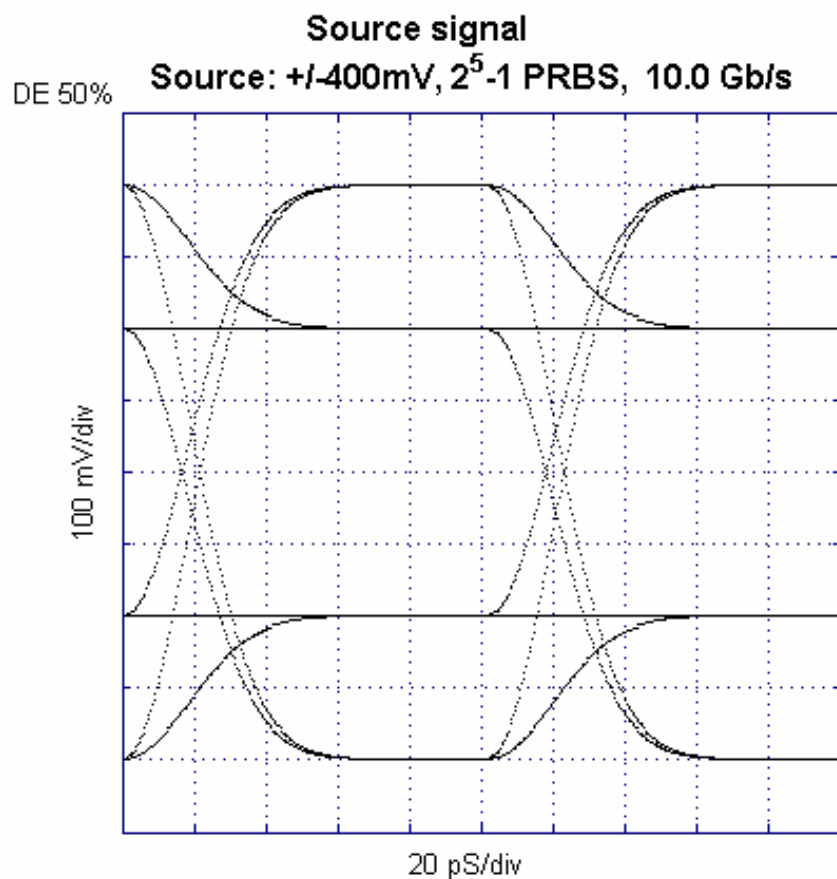
Various levels of de-emphasis without equalization

Eye patterns for FR4 transfer function



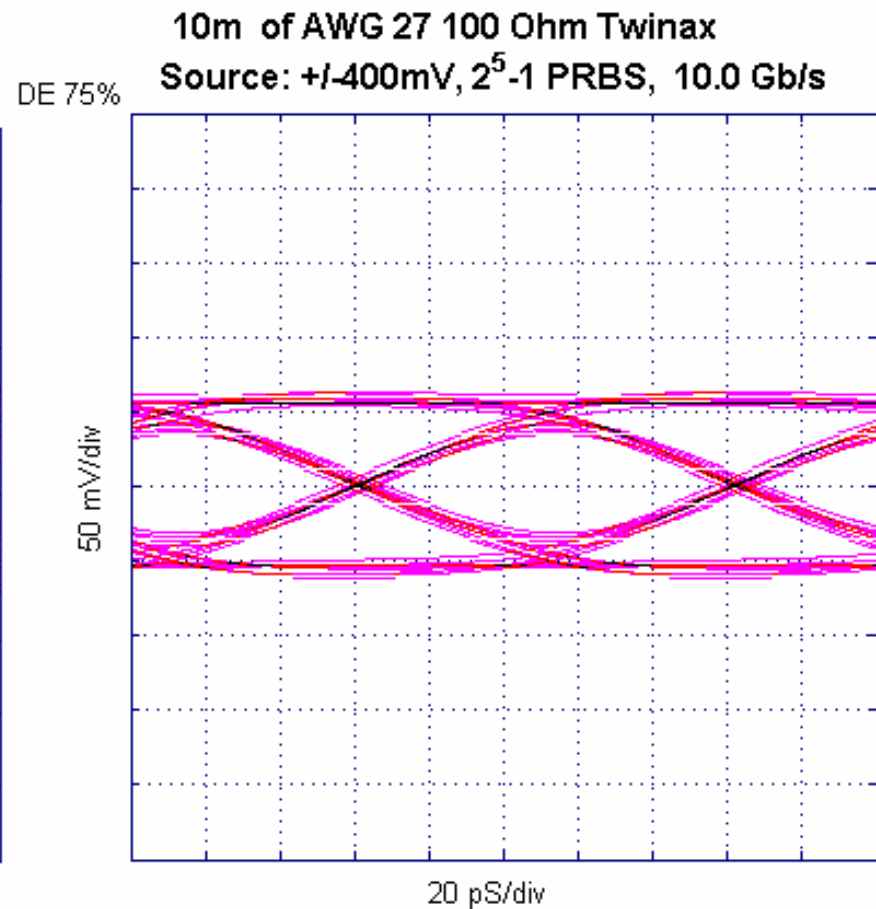
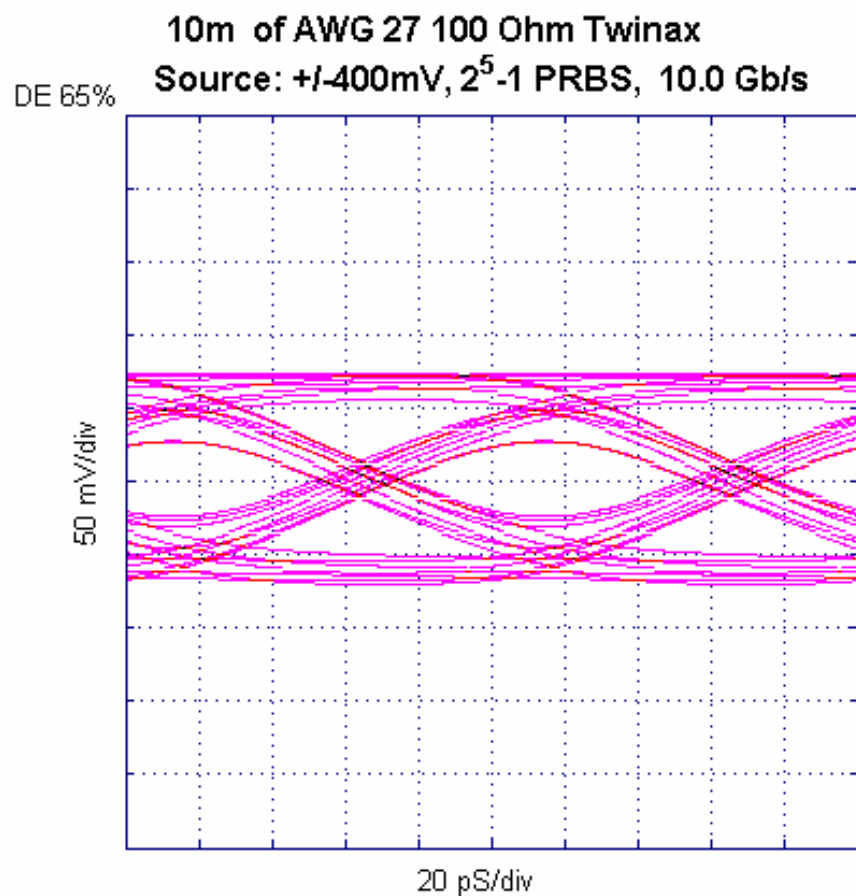
Various levels of de-emphasis without equalization

Eye Patterns for 24 AWG cable -10 to 12 meters



Various levels of de-emphasis without equalization

Eye Patterns for 24 AWG cable -10 to 12 meters

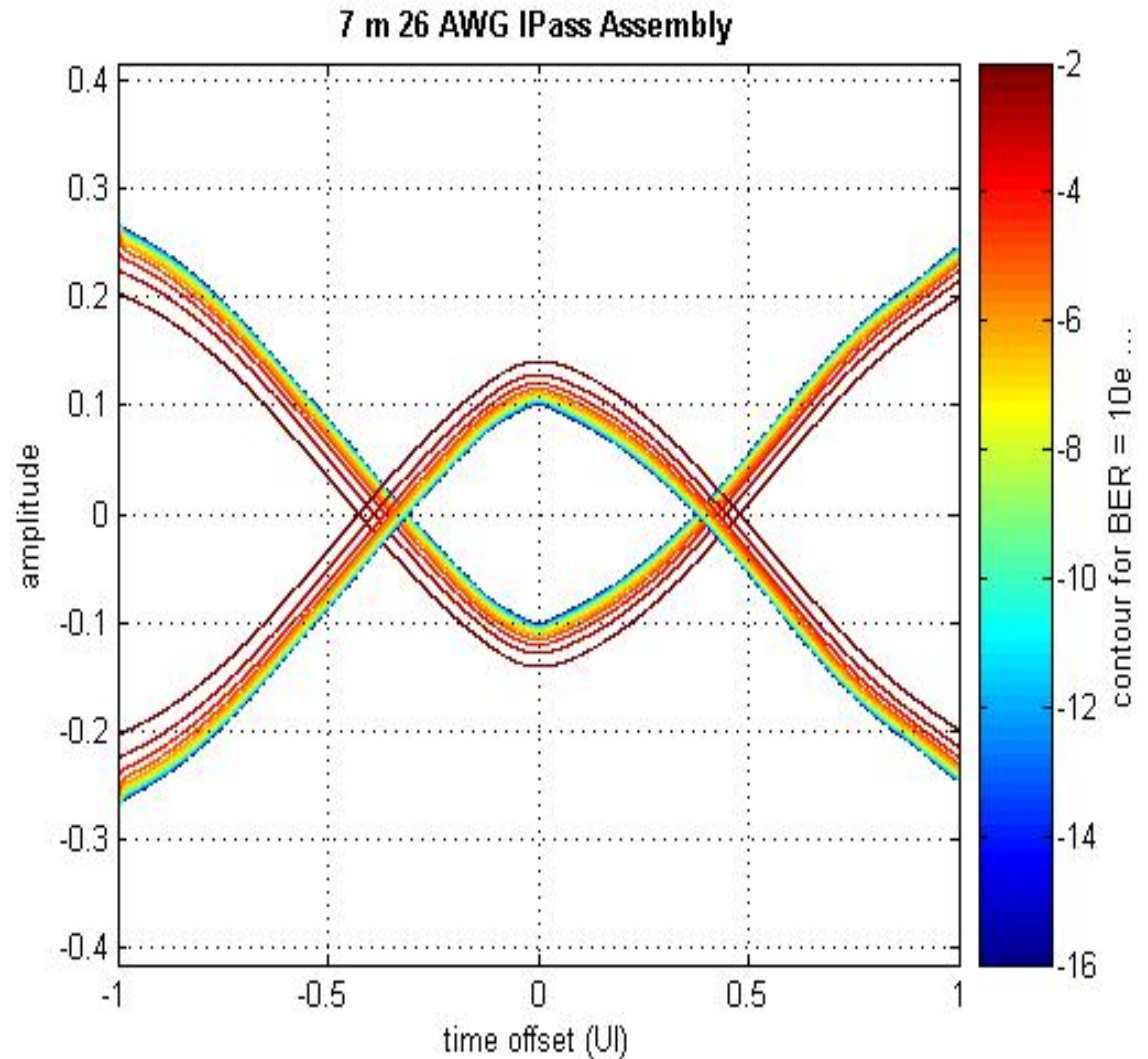


Various levels de-emphasis without equalization

StatEye - 7 meter 26 AWG IPass Assembly

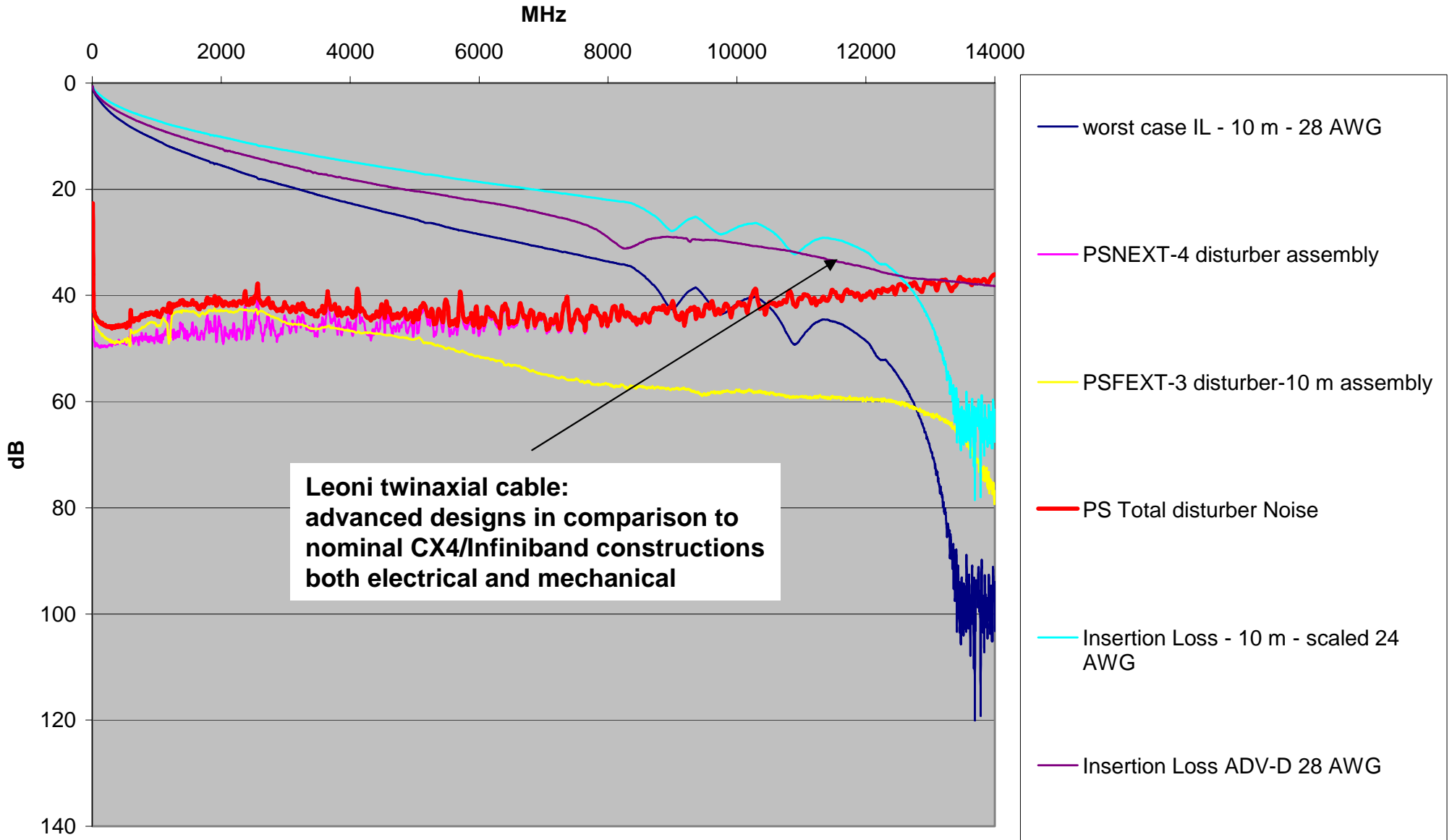
Simulation settings:

- 10.3125 Gb/s
- Optimized TX de-emphasis
- Vpp = 1 V
- 3-tap RX DFE



Source: Gourgen Oganessyan, Molex, Leoni High Speed Cables

Cable assemblies - 28 AWG/24 AWG/28 AWG ADV-D 10 meter

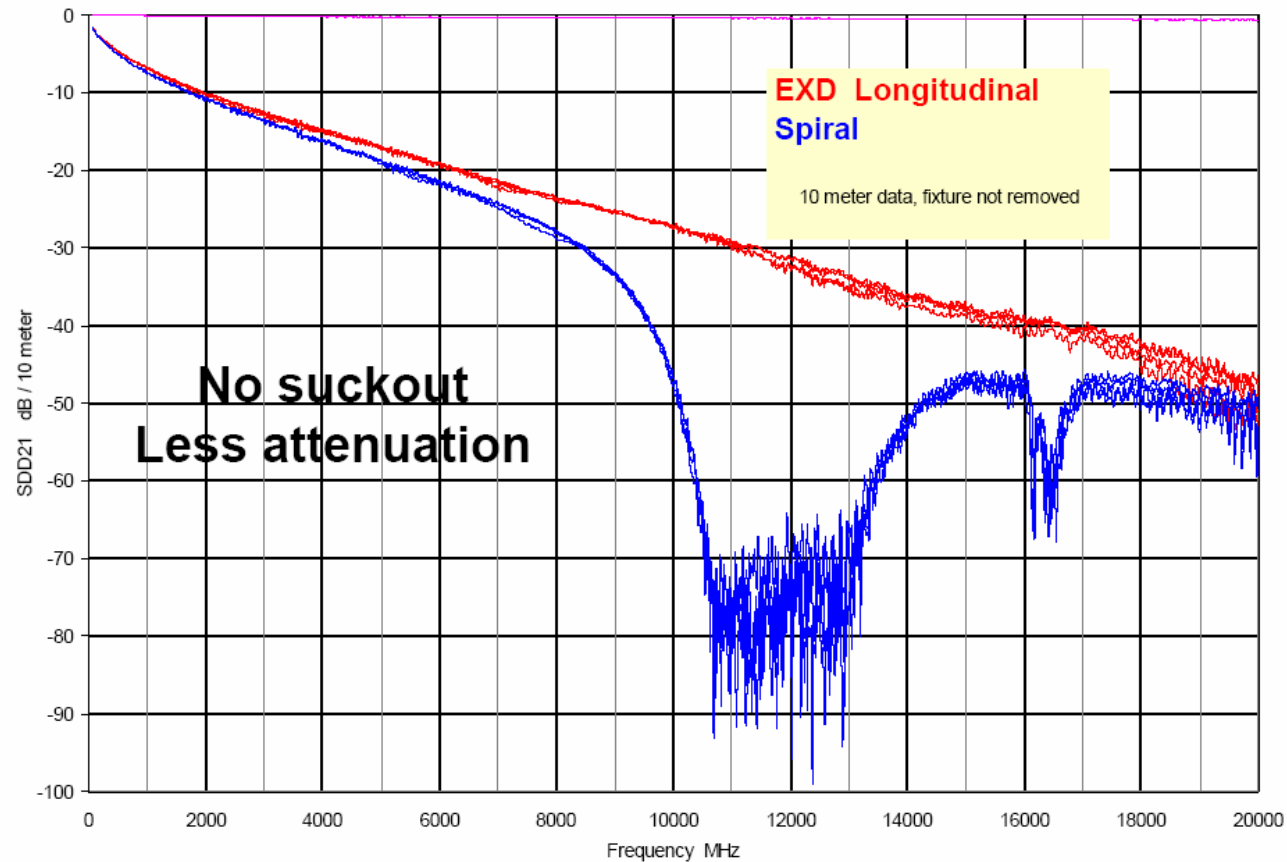


Source: Leoni High Speed Cables

IEEE 802.3 HSSG

Cable comparison

Bulk cable comparison:
4 lane longitudinal pair shield vs. spiral pair shield
100 ohm 24 AWG solid silver plated copper, foam PE, aluminum / polyester shield



Source: Clark Booth, Amphenol Spectra Strip

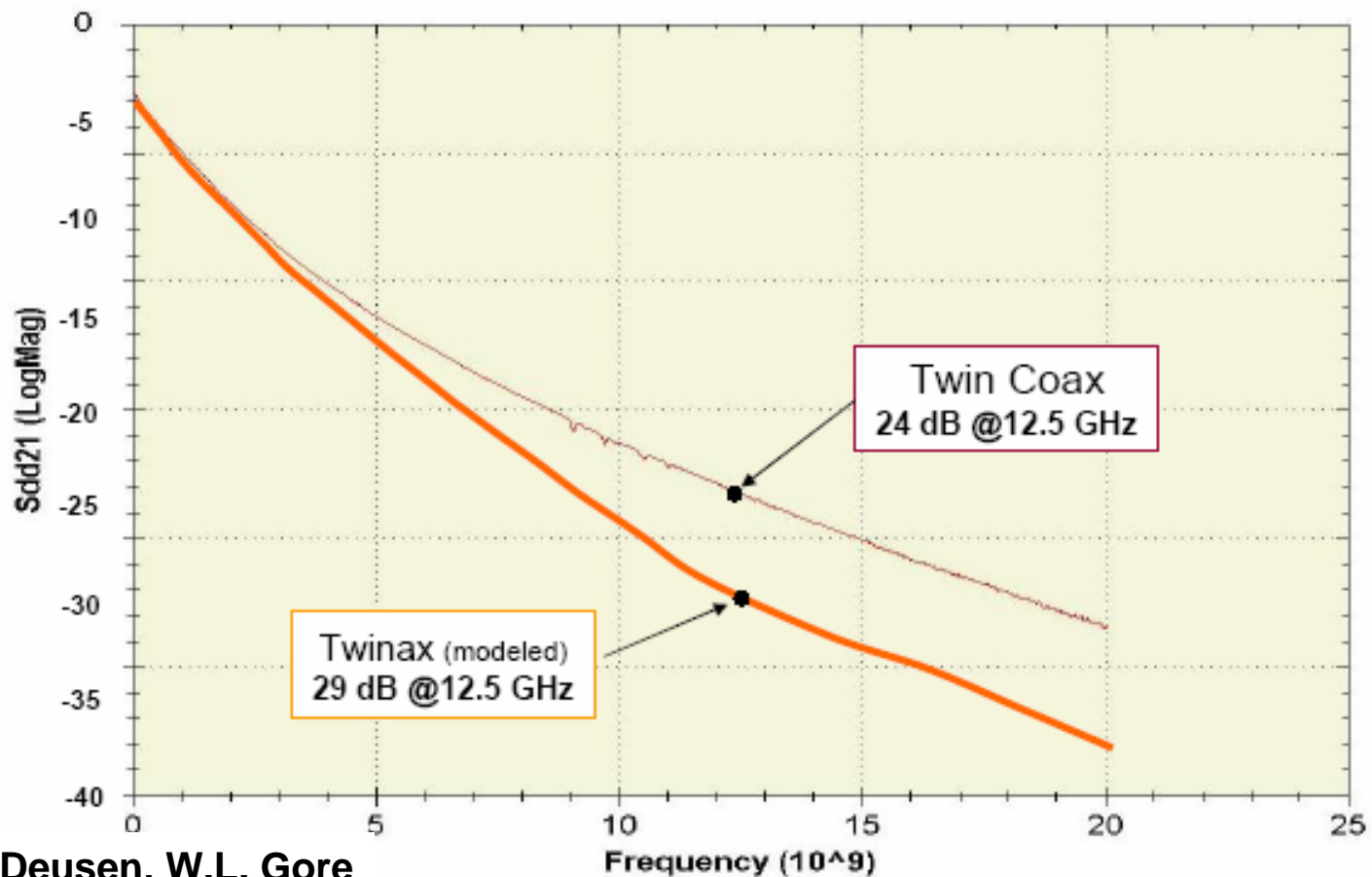
IEEE 802.3 HSSG

Cable Designs

Cable Designs for 25 Gb/sec

10 meter AWG24 loss comparisons

Coax has lower loss but twinax designs are improving and have smooth frequency response thru 15 GHz



Source: Herb Van Deusen, W.L. Gore

IEEE 802.3 HSSG

Lane Rate, Signaling rate, channel bandwidth

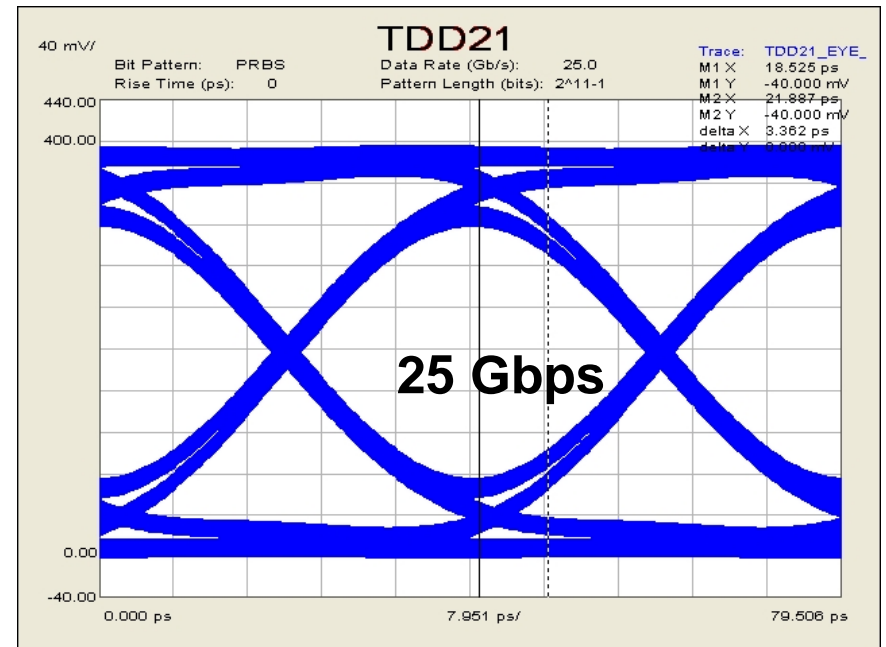
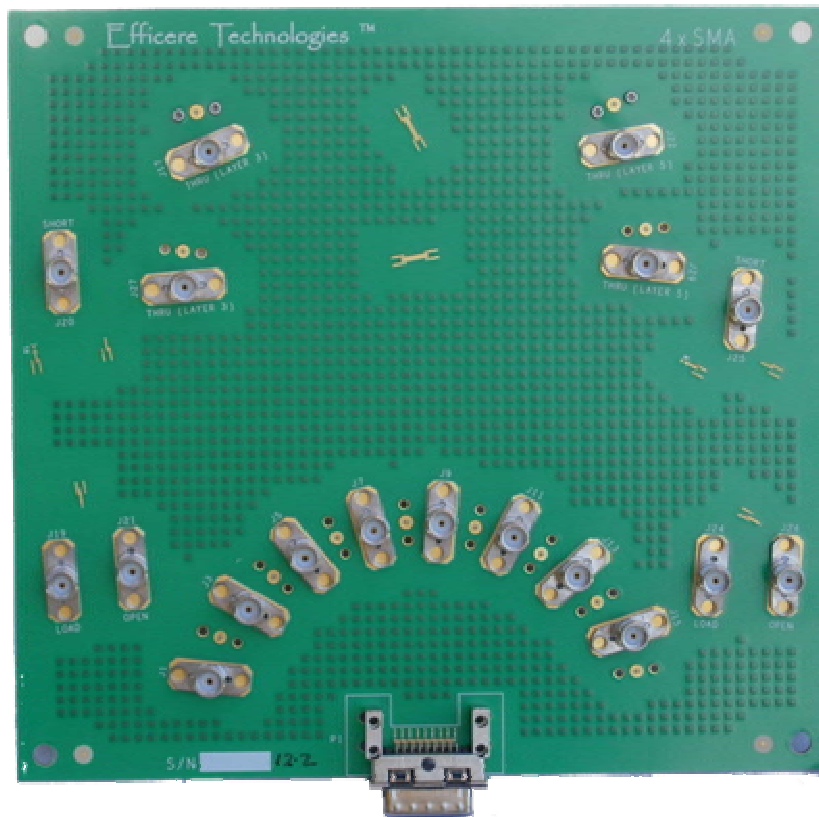
10 m cable + connectors @ 6 dB Margin

Maximum Lane rate	Maximum signaling rate	Info bits/ baud/dim	Channel bandwidth	Copper Gauge	Code gain	Length
Mb/s	Mbaud		MHz	AWG	dB	meters
10889.28	8180.00	1.33	4090.00	28	0	10
13984.52	10140.00	1.38	5070.00	28	2	10
17555.24	11360.00	1.55	5680.00	28	4	10
>24950.75	>17290.00	1.44	8645.00	24	0	10
>30727.91	>17400.00	1.77	8700.00	24	2	10
>36785.11	>19000.00	1.94	9500.00	24	4	10
>17212.31	>13210.00	1.30	6605.00	28 ADVD	0	10
>22044.24	>14580.00	1.51	7290.00	28 ADVD	2	10
>27147.01	>15460.00	1.76	7730.00	28 ADVD	4	10

HSSG copper- Lane rate(s) > 10 Gb/s

4X-SMA 25Gb Test Adapter

- 25 Gbs per differential pair



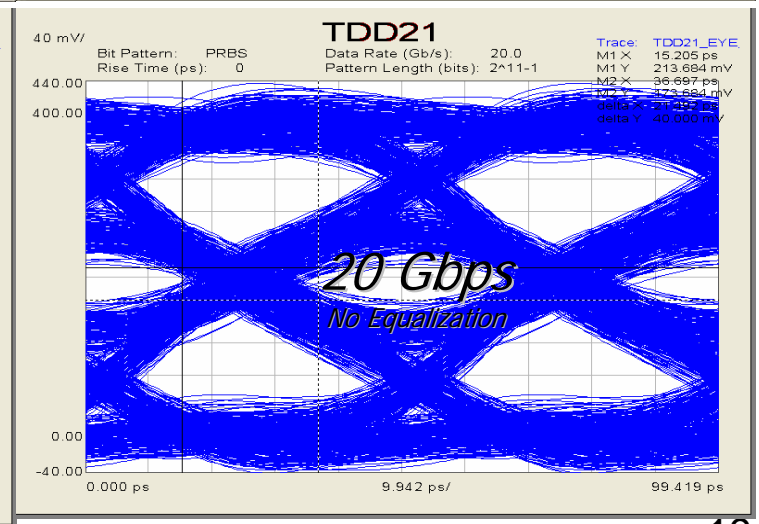
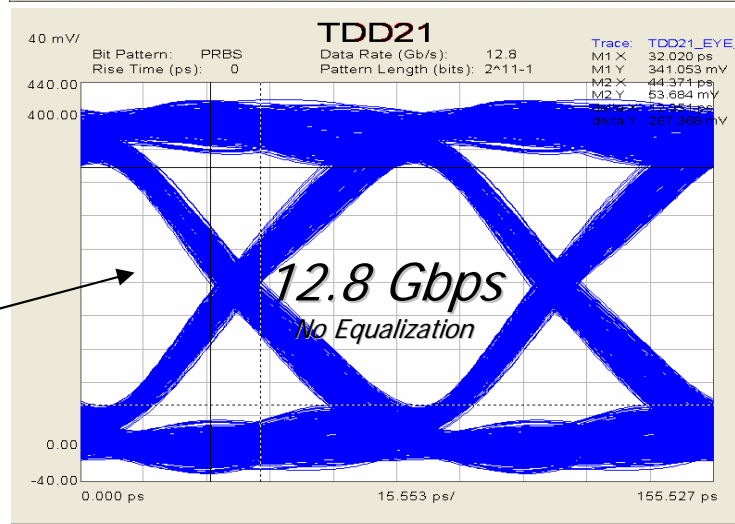
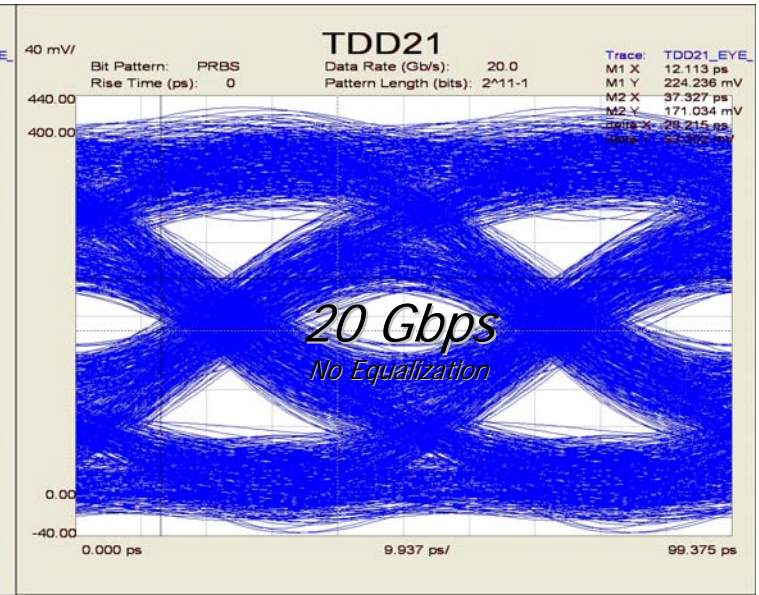
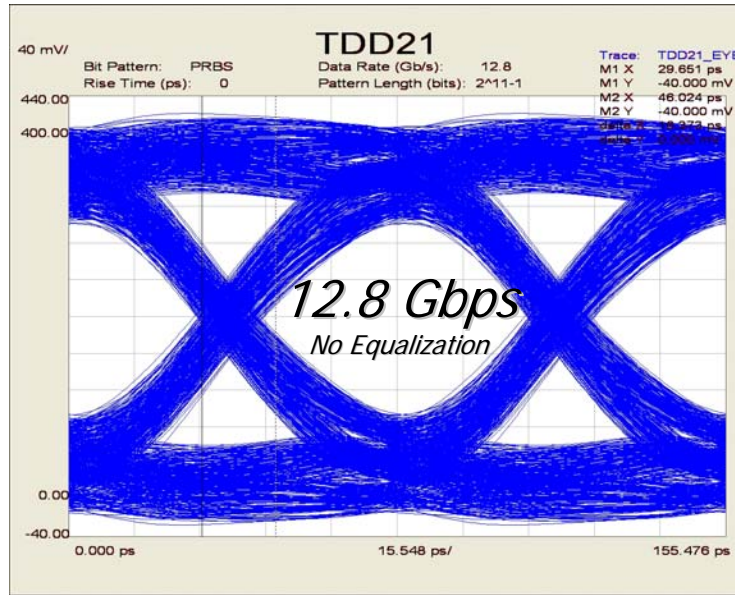
HSSG copper- Lane rate(s) > 10 Gb/s

4x-SMA-25 Gb... Board-to-Board

Board to board ...
2 test boards
calibrated to the
4x launch

Receptacle launch
and copper
interconnect
enhancements
in development

Honda
Connector
Two 4x receptacles



Source: Efficere Technologies

IEEE 802.3 HSSG

Conclusions

- **Technical feasibility, economic feasibility, and market potential for a Higher Speed copper interconnect demonstrated.**
- **Up to 10 meter reach consistent with intra/inter rack application and HPC cluster distances.**
- **High speed study group should add high speed copper interconnect objective of up to 10 meter reach over copper to address intra/inter rack applications and high performance computing (HPC) interconnects.**

Cu in Task Force