HSSG copper objectives and five criteria

Prepared by:
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100 GbE copper interest list

- Michael J. Bennett, LBLnet Services Group
- Yakov Belopolsky, Bel Stewart Connector
- Ed Cady, Meritec
- Larry Cohen, Independent
- Suveer Dhamejani, Tyco Electronics
- 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**

Presentation objectives and non-objective

- **Identify HSSG copper objectives**
- **Expand development of five criteria**
- **Demonstrate multi-vendor support**
- **Non objective – choosing a solution**

HSSG copper objectives

- **Support full-duplex operation only.**
- **Preserve the 802.3/Ethernet frame format at the MAC Client service interface.**
- **Preserve minimum and maximum FrameSize of current 802.3 Std.**
- **Support a speed of 100 Gb/s at the MAC/PLS service interface.**
- **Support at least 10 m over copper**
- **Support a BER better than or equal to 10-12 at the MAC/PLS service interface.**

Presentations

Contributors

- **Participants of the 100 GbE copper interest list**

Market Requirements and Potential Presentation

1. **Mike Bennett - The need for a low-cost 100GbE inter-rack copper interconnect**

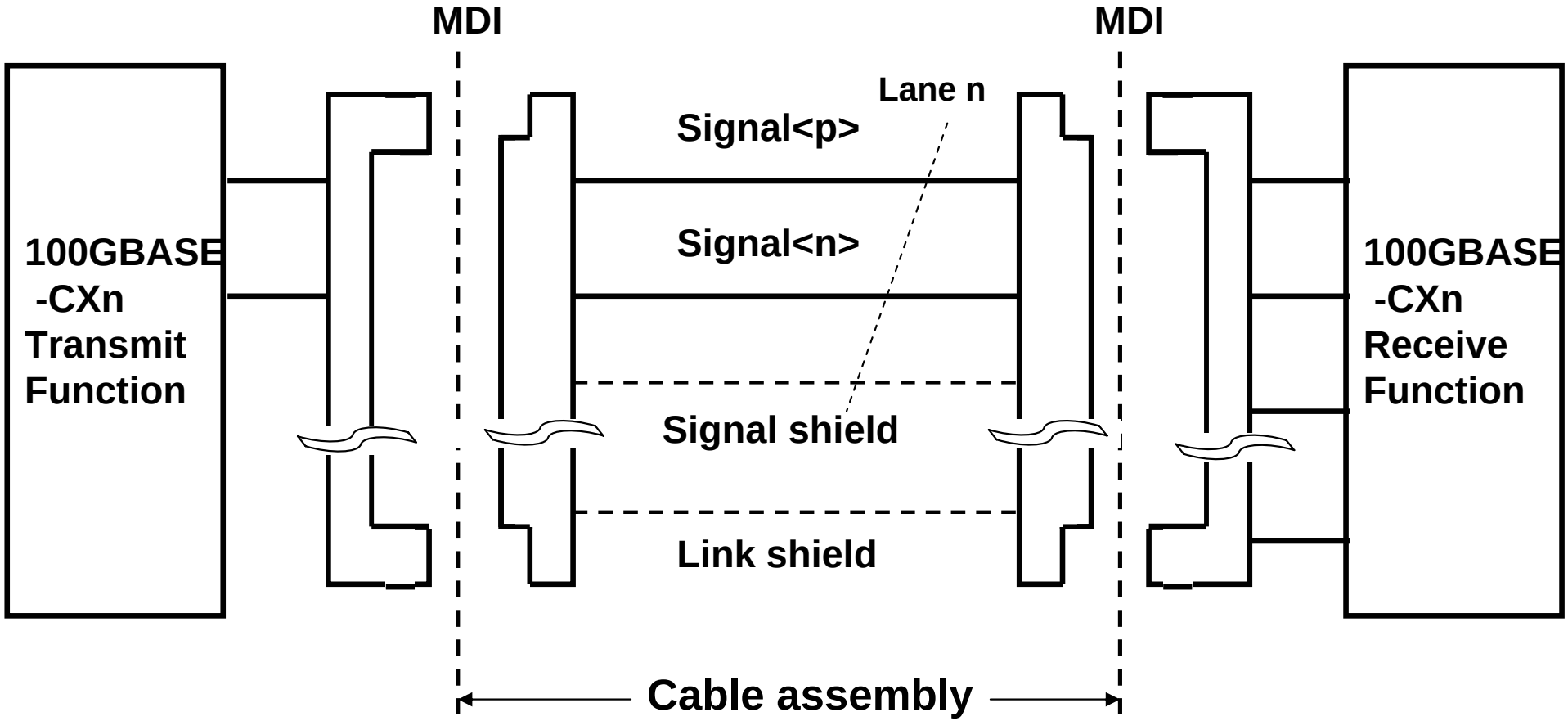
Technical Feasibility and Economic Feasibility Presentations

2. **Chris DiMinico, MC Communications; George Zimmerman, Solarflare Communications –Twinaxial cable assembly transmission characteristics**
3. **Herb Van Deusen – W.L. Gore - High Speed Cabling Guidelines**
4. **Carl Booth – Amphenol Spectra-Strip, 24 AWG twinaxial cable structure for 25Gb applications**
5. **Gourgen Oganessyan, Jim McGrath – Molex – 100G Copper Proposal: Technical Feasibility**
6. **Will Miller - Efficere Technologies – 100G Ethernet Test Fixture**

Overview 100 GbE

- **100GBASE-CXn link**
- **100 GbE lane rates (for discussion)**
- **10 Gb/s copper interconnect market**
- **100 Gb/s copper interconnect applications**

100GBASE-CXn link



100 GbE – Lane rate(s) – for discussion

100 GbE	lane rate Gb/s	Length (m) Passive cable	cable available	connector technology available
parallel	10 x 10	up to > 10 (TBD)	Yes	Yes
parallel	5 x 20	up to >10 (TBD)	Yes	Yes
parallel	4 x 25	up to >10 (TBD)	Yes	Yes

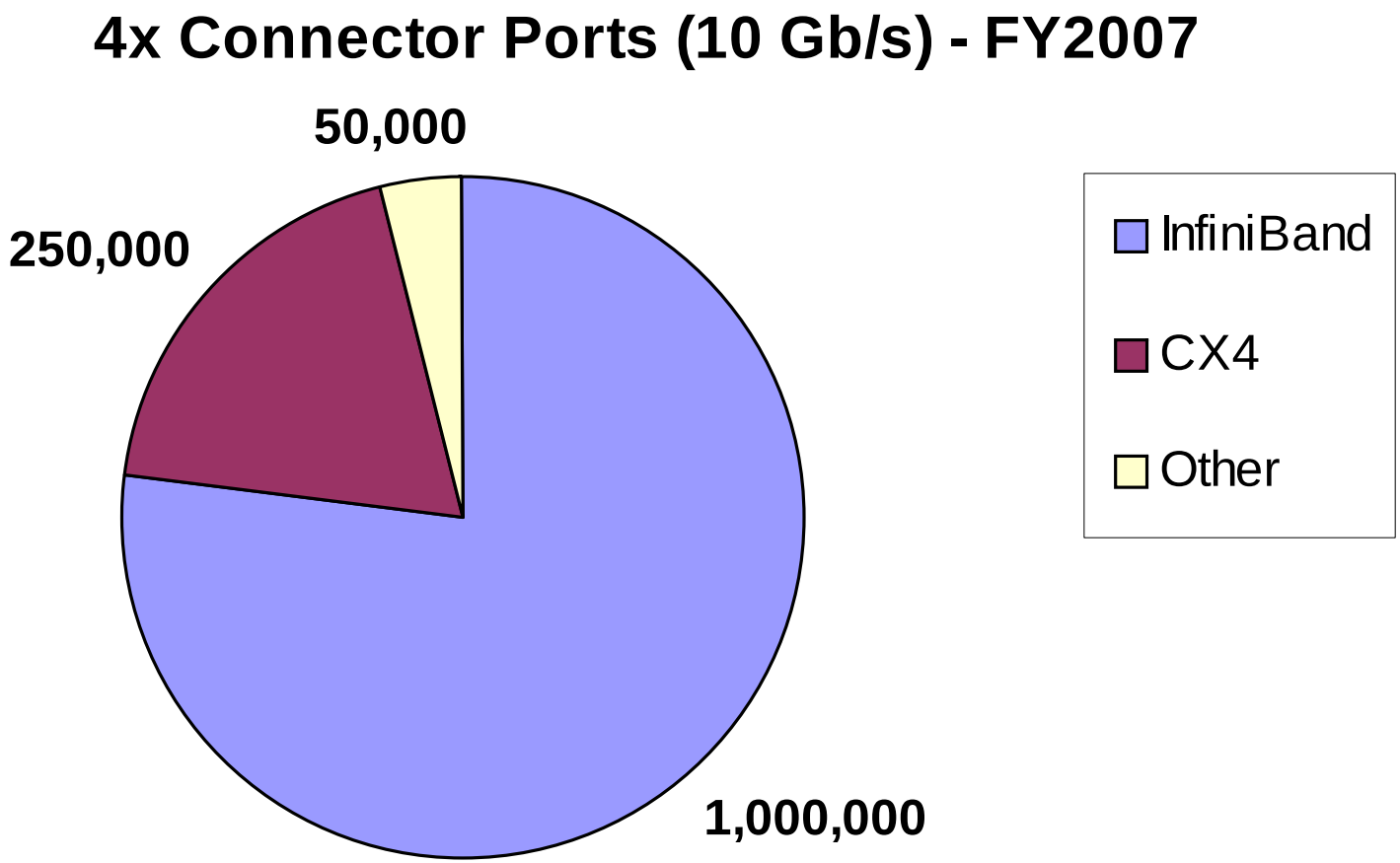
•Please note these rates are offered for discussion based on input from the call for interest list group. They are not to be considered as recommendations to the HSSG.

10 Gb/s copper interconnect market

10 Gb/s – High Speed Copper Interconnect

InfiniBand Protocol	Signaling (Gbd)	Length (m) (loss based)
parallel	4 x 2.5	10
Ethernet Protocol	**Signaling (Gbd)**	**Specified length (m)**
10GBASE-CX4 (parallel)	4 x 3.125	up to 15
Fibre Channel Protocol	**Signaling (Gbd)**	**Length (m)**
parallel	4 x 3.1875	10
PCI Express	**Signaling (Gbd)**	**length (m) (loss based)**
parallel	4 x 2.5	7

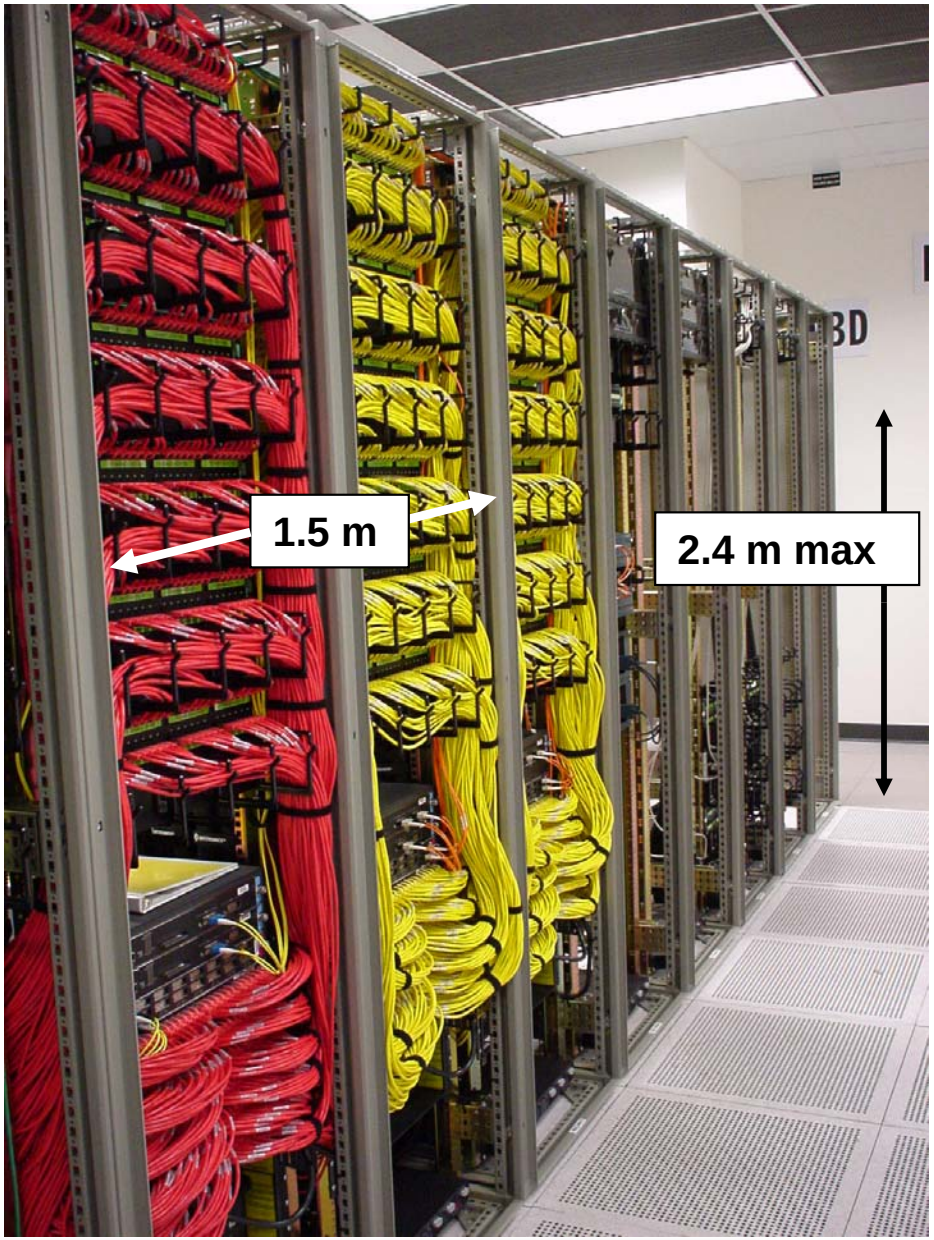
4x Connector ports - FY2007



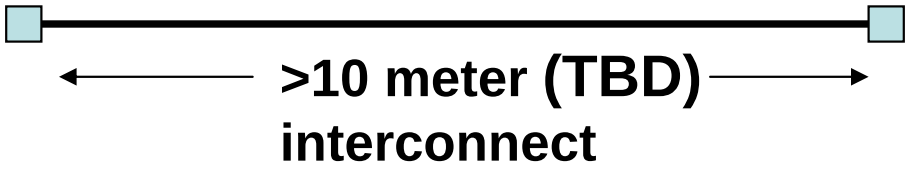
Source: members HSSG copper interest group list

100 Gb/s copper interconnect applications

High Speed Copper Interconnect: Applications



Intra/Inter rack/cabinet applications and High Performance Computing Interconnect



TIA-942 - Cabinet and rack height

- **The maximum rack and cabinet height shall be 2.4 m (8 ft).**
- **Preferably no taller than 2.1 m (7 ft) for easier access to the equipment or connecting hardware installed at the top.**

Conclusions

- **Technical feasibility, economic feasibility, and market potential for a 100 Gb/s copper interconnect will be demonstrated.**
- **Up to 10 meter (TBD) reach consistent with intra/inter rack application and HPC cluster distances.**
- **High speed study group should add high speed copper interconnect objective to address intra/inter rack applications and high performance computing (HPC) interconnects.**

BACKUP SLIDES

Market Potential

Broad set(s) of applications
Multiple vendors, multiple users
Balanced cost, LAN Vs. attached stations

•The sweet spot for HPC is closer to 10 m; 5 meters probably won't work well in our high performance computing (HPC) environment since the physical dimensions of the cluster and storage systems is large.

•Computer room where large switches need consolidating connections to the end-systems (large clusters, storage). These switches are close enough to the end-systems to use copper or MM fiber whenever possible.

•Low density Inter-router/switch connections within a rack or two. We're talking ten ports max.

•Interconnect for HPC clusters requiring very high reliability.

Market Potential

Broad set(s) of applications
Multiple vendors, multiple users
Balanced cost, LAN vs. attached stations

Applications listed below largely based on questionnaire responses designed to solicit end-user input on the market potential for 100 GbE over copper.

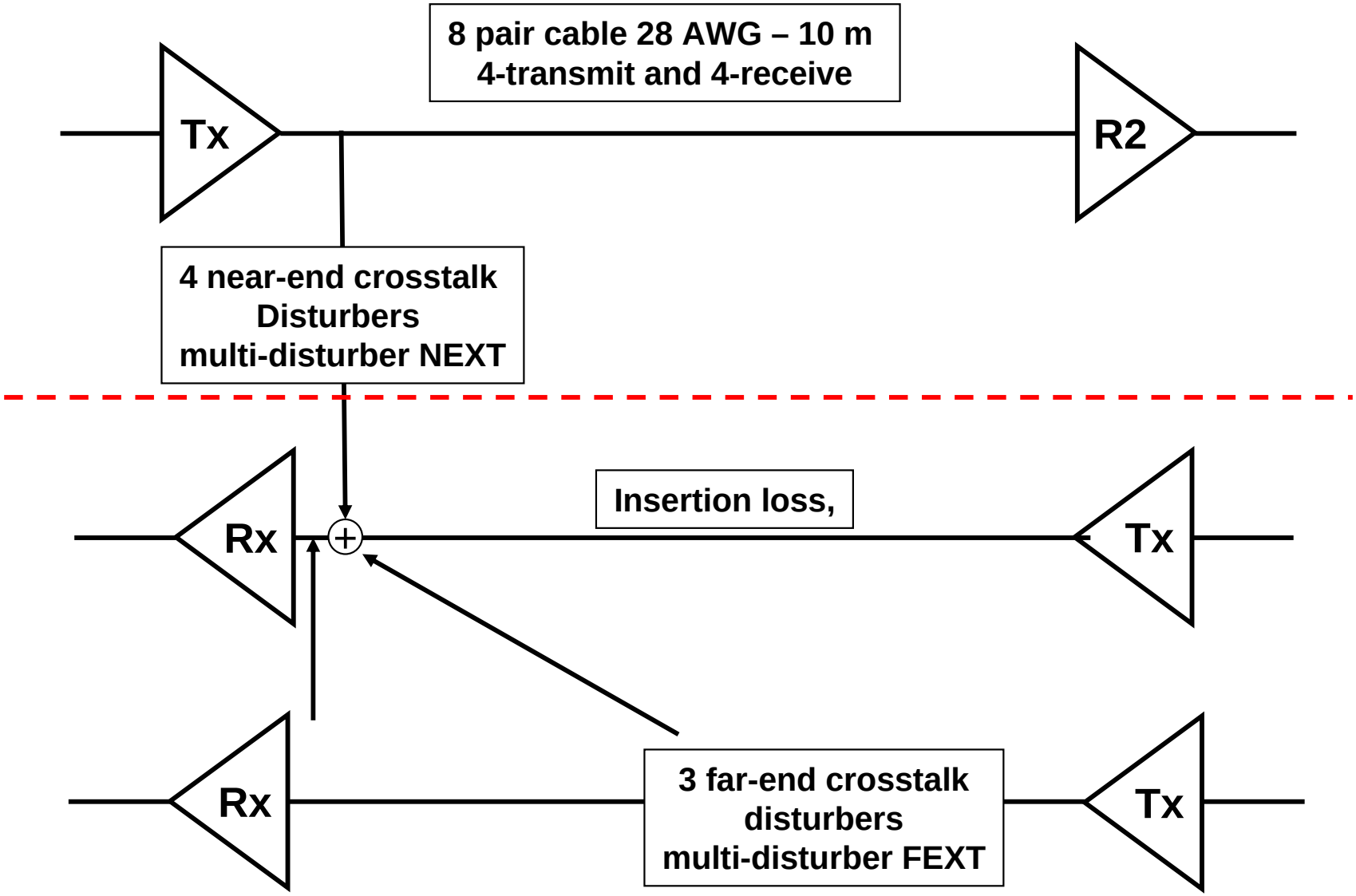
Respondents: Pacific Northwest National Laboratory, ESnet Network Engineering Group, Lawrence Berkeley National Laboratory; Electronic Systems Engineering, Computing Division, Fermilab US DOE; Lawrence Livermore Nat'l Lab (LLNL)

•Right now there is a need to move and process/analyze 100+ Petabyte data sets between supercomputer and storage nodes.

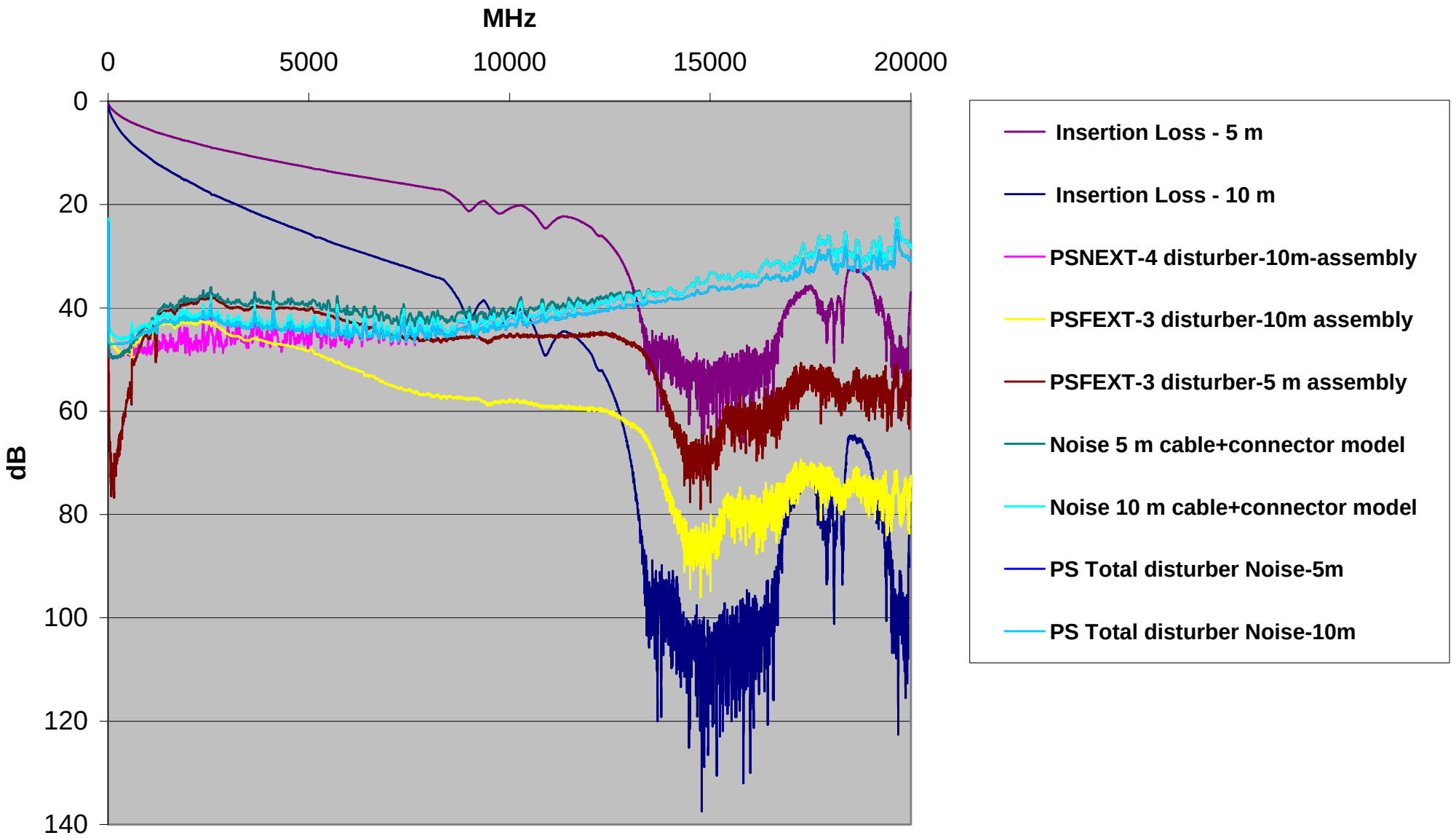
•Datacenter or computer room, 100-GbE copper to a 100GbE copper+fiber router/switch.

•Low-cost interconnect between networking equipment (e.g., routers, switches, etc) in a telecom POP or at the network edge for peering or customer handoff. There is a need for 100GE customer handoff and peering within 5 years.

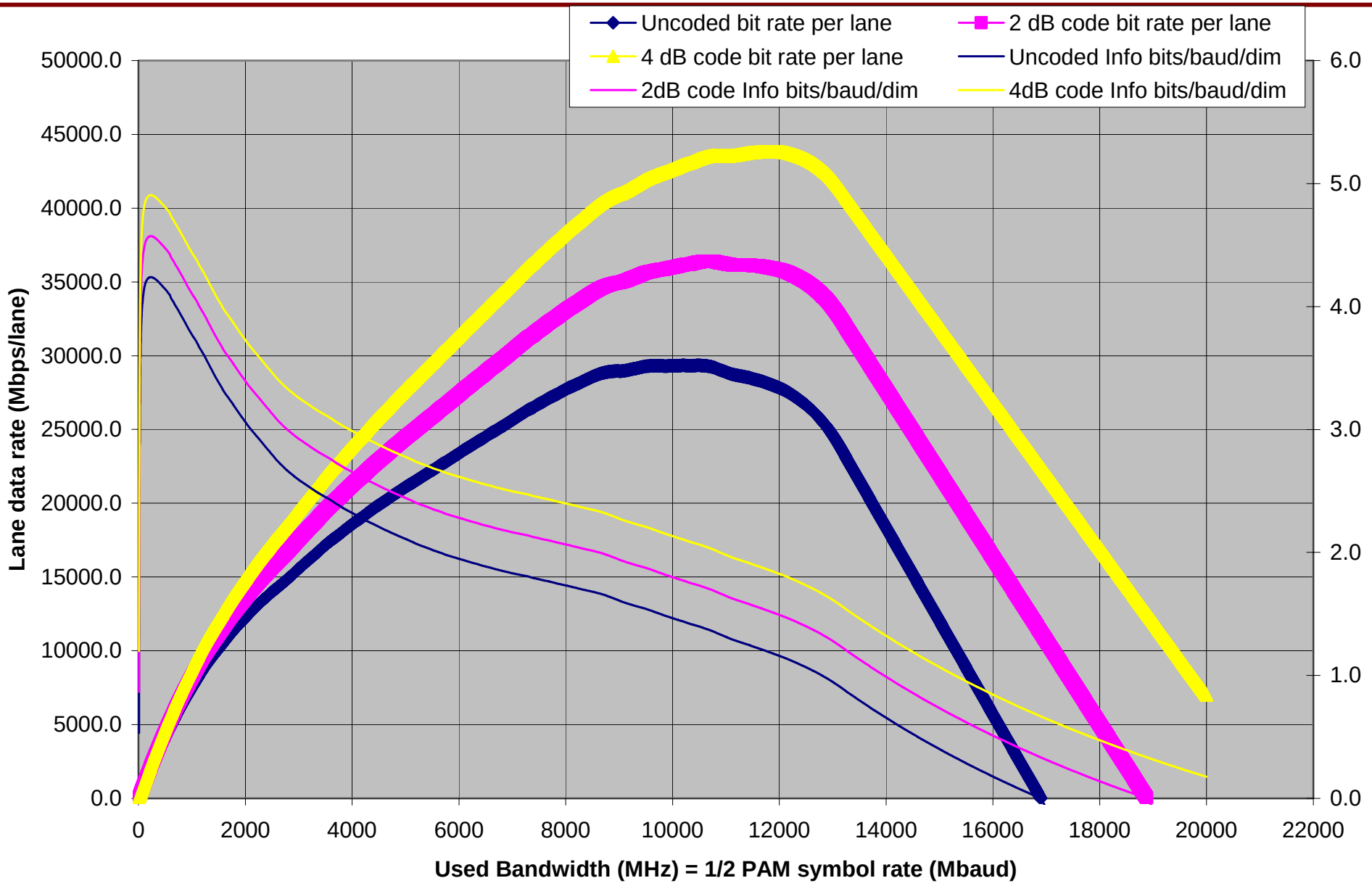
Analysis: Copper Interconnect S-parameters



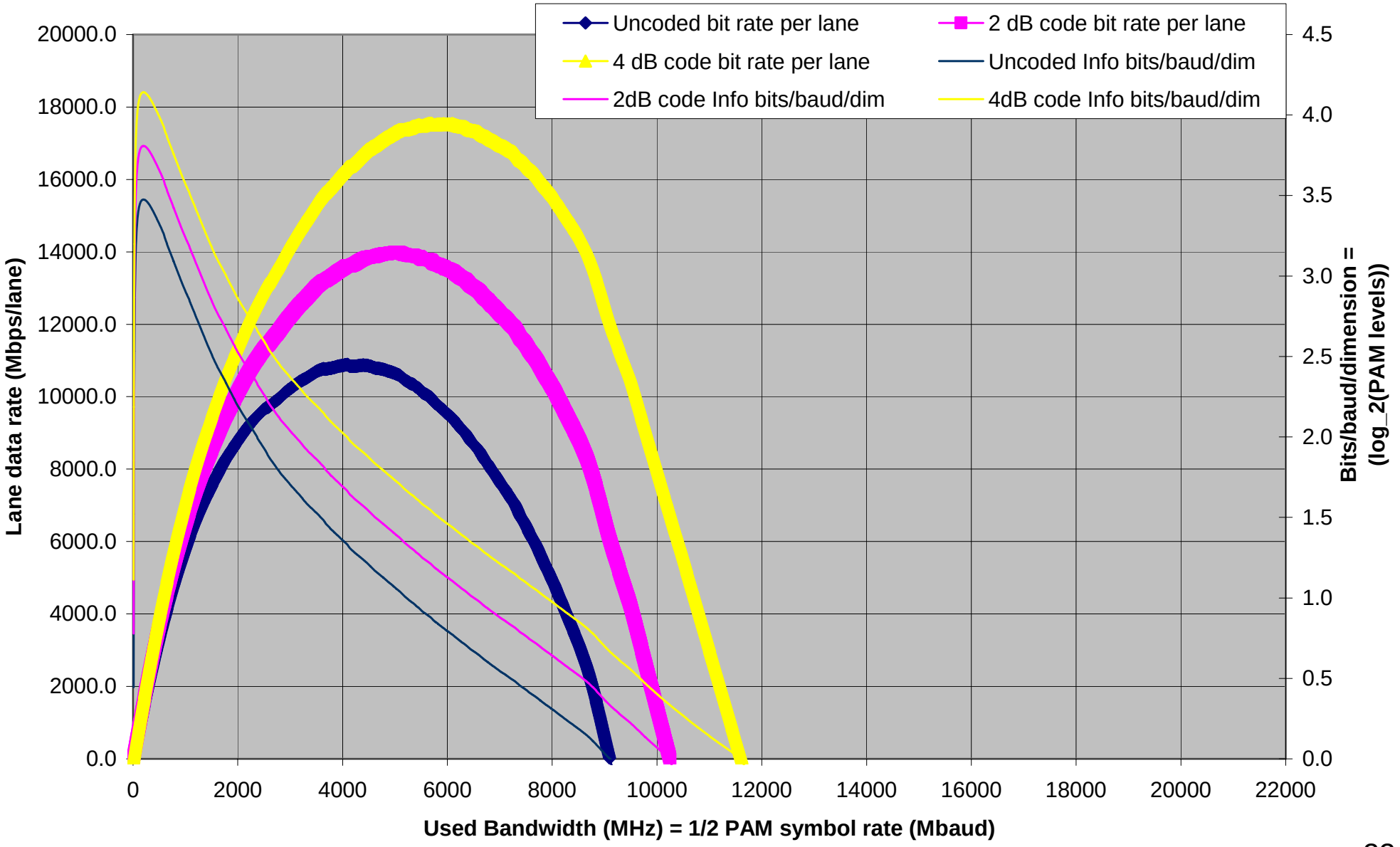
Interconnect Transmisson Characeristics



Lane Rate vs. 1/2 PAM symbol rate
6 dB Margin, 5m cable + connectors



Lane Rate vs. 1/2 PAM symbol rate
6 dB Margin, 10m cable+connectors



Cable Salz SNR - 0 folds