10 GbE Link Modeling

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Link Model Purpose

- The GbE Link Model is **NOT** part of any standard
- This model was helpful in setting optical and electrical specifications and resolving GbE issues.

.: Focus must be put on the latter, not modeling itself

P.S. Del Hanson, David Cunningham, et. Al., have done a superb job modeling optical links. I mean absulotely no disrespect to these efforts

GbE Spreadsheet Model

- Represents only limited attributes of 1 GbE links
  - Only deals with light intensity (optical power)
- May only be capable of representing a small subset of 10 GbE PHY attributes accurately
  - Multi-channel PHYs: Parallel Optics, WWDM
    - Must consider optical crosstalk, heating effects, power limits due to Laser Safety regulations, other multi-channel effects
  - Multi-level PHYs: PAM-5, PAM-n, QAM
    - Alternate coding, FEC coding gain, link calibration,
  - DFB lasers, long SM links, 1550 nm, scrambling
  - Combo PHY's: multi-level, multi-channel, etc.

Spreadsheet Model Gottchas

- Easy to “get around” model: **More Optical Power**
  - Especially applicable to single-channel links
  - Direction is to relax (slightly) Laser Safety req’ts
    - More power available at 1300 nm than 780-980 nm
    - Even more available at 1550 nm
  - Power can be increased by intelligent link design
    - Use Link Calibration during AN to optimize links
- Link Simulation required for accurate evaluation:
  - to properly assess coupling between different penalties
  - to properly consider non-linear effects
  - to properly simulate the entire PHY (Tx-Fiber-Rx)

Alternative Modeling Proposal

- Focus on 802.3 HSSG Objectives
- Continue to develop multiple 10 GbE PHYs as a first order effort
- Use modeling techniques to identify PHY issues and to assist in setting electro-optic specifications as a second-order effort
- The development of a Universal Link Model for 10 GbE could turn into a “Holy Grail” effort