10 GbE Fiber Optic Links - Link Model Update

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Outline -

* **Mode Partition Noise**

* **Narrow linewidth, chirped laser sources**

* **Optical Crosstalk (in WDM systems)**

* **Other modifications**

Mode Partition Noise Penalty - Proposal:

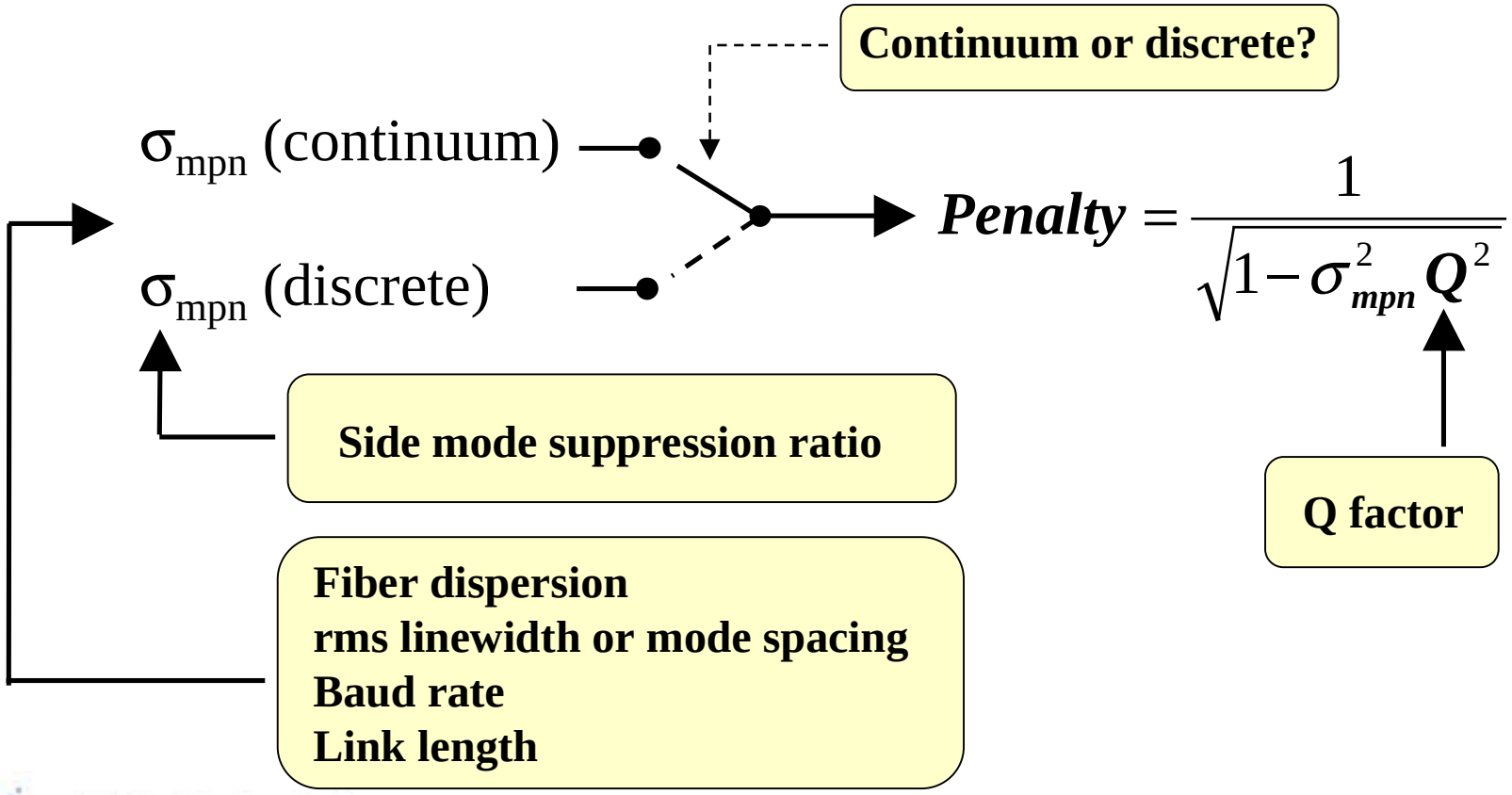
Current treatment of MPN using Gaussian continuum approximation for the source spectrum should continue to be used for following sources:

- Fabry-Perot (FP) edge emitting lasers
- Vertical cavity surface emitting lasers (VCSELs)
- DFB lasers with very high Side Mode Suppression

Discrete sum of modes expression (based on Ogawa's original theory) should be used for lasers with two modes (for example, DFB lasers with finite Side Mode Suppression)

Mode Partition Noise Penalty - con't:

Can easily incorporate both expressions into the current Spreadsheet model with parameter set by the user which selects desired form of the MPN variance:



Narrow linewidth, chirped sources:

Current status:

We have obtained good agreement between Marcuse's Gaussian model [1,2] and numerical link simulation model in the vicinity of 1300 nm for lasers with moderate risetimes (> 50 psec).

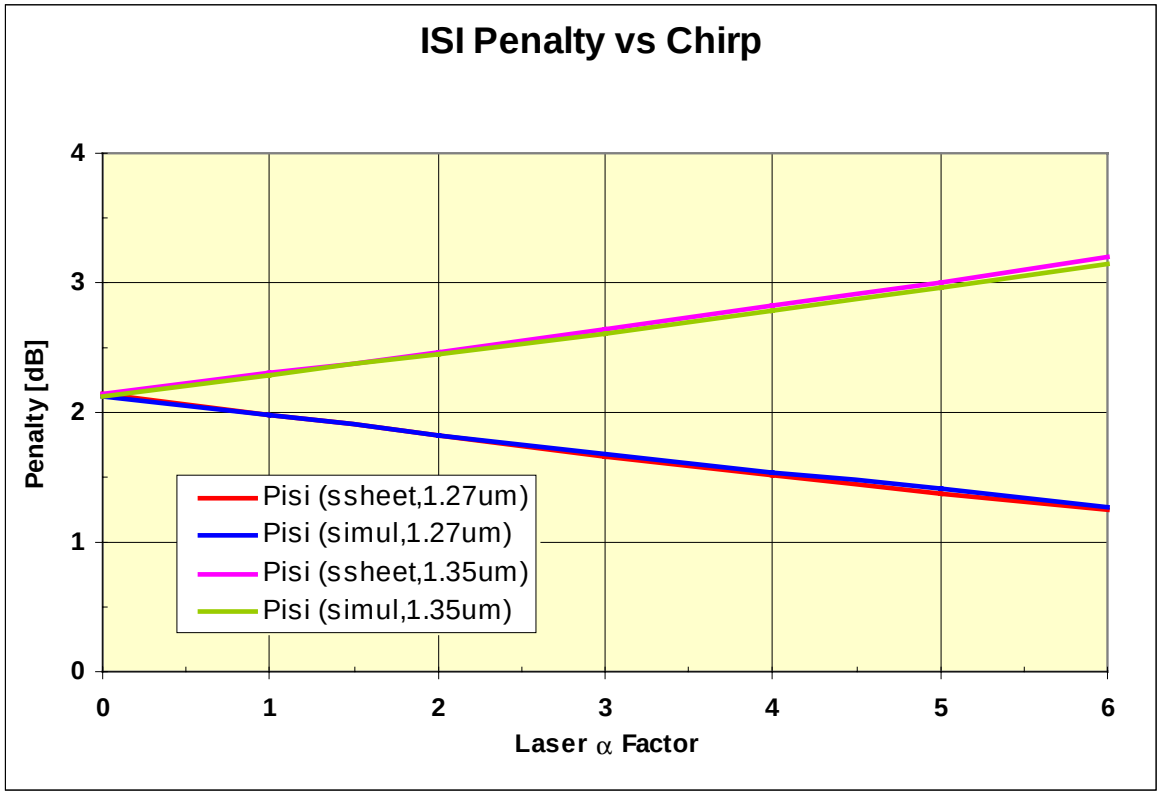
Remaining work:

1. Investigate 1550 nm region (large values of dispersion)
2. Investigate lasers with fast risetimes (< 25 psec)
3. Initiate experimental investigation of chirped lasers

[1] Marcuse, D, Applied Opt **19**, 1653, 1980……
[2] Marcuse, D., Applied Opt **20**, 3573, 1981…….

Narrow linewidth, chirped sources (con't):

One Example: Comparison of Spreadsheet with Gigabit Optical Link Designer (GOLD) numerical simulator:



Parameters:

Laser 10-90 risetime: 70 psec
Baud rate: 12.5 GBd
Link length: 10 km
Laser wavelengths:
λ_1 = 1.27 μ
λ_2 = 1.35 μ

Crosstalk in WDM Based Systems:

Optical crosstalk from adjacent channels will create a power penalty:

$$\textbf{\textit{Penalty}}\,(\textit{dB}) \cong 10\log(1+\textit{X}) \qquad \textit{X} = \frac{\textit{P}_{\textit{xtalk}}}{\textit{P}_{\textit{signal}}}$$

However, since this occurs in the demultiplexer of the receiver, it is proper to include it in the receiver sensitivity rather than as a system penalty.

Other Areas to be Addressed:

1. Possible Modification of RIN Penalty
2. Investigation of impact of Multi-level coding on Power Penalties
3. Investigation of Modal Noise Penalty for 10 Gb systems
4. Closer linkage of Spreadsheet Model to jitter budget
5. Investigate Duty Cycle Distortion (DCD) contribution to Deterministic Jitter - Possible modification to current method of increasing effective Baud Rate.