Enhanced Spreadsheet Model for 10Gb/s MMF Links

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Why this presentation?

• Not to ask to change current Ethernet and FC spreadsheet models
• Not to offer new model (for now)

• Show what feature enhancements are possible
  – True signal propagation, eye diagrams
  – Possibility to include equalizer structures
  – Incorporation of models of arbitrary complexity

• Demonstrate user interface simplification
Modeling approach in the Ethernet spreadsheet model

• Assumes Gaussian signal shapes and transfer functions, uses approximate formulas
• Propagation effects can not be added in a simple manner
  – DMD effects and launch effects (pulse splitting etc.)
  – Group delay distortions
  – Chirp
  – Reflections
• Uses power model assumptions exclusively – not accurate for predicting 1300nm and 1550nm SMF link performance
• Uses effective baud rate instead of base rate to take into account deterministic jitter effects
  – Noise calculations affected (mode partition noise, RIN), chromatic dispersion effects affected
  – Jitter calculation affected
• Formula assumptions inaccurate for some noise models
  – Mode partition noise – continuum of modes is not valid assumption
• Low frequency cut-off added as a noise penalty, may be inaccurate
Why do we still use it?

✓ It is cost effective (free)
✓ Instant results – push of a button
✓ Runs on Excel – virtually on any PC
✗ Overestimates some and underestimates other penalties, overall accurate

Why do we need changes to the model?

• Optimal trade-offs between link components may be affected, leading to higher total link costs
• Equalized links can’t be easily simulated
Typical Link Diagram

TX

Data In

Laser Driver

Laser Diode

Optical Fiber

(MMF 50, 62.5 μm or SMF)

RX

PD+TIA

PA

Data Out

TP1

TP2

TP3

TP3.5

TP4
Excel Add-in

• Based on IBM Multimode Fiber Model presented at the January Interim in Vancouver, BC

✓ Models developed in Matlab were translated to C++, compiled and Excel add-in created
  – Retains advantages of full blown simulator

✓ Similar interface to existing Ethernet spreadsheet model
  – Fewer cells
  – Demo version does not have all bells and whistles
    ✗ Takes ~10 sec to compute link budget for 10 lengths (CPU speed dependent)

✓ Creates eye diagrams

✗ User can’t make changes to the compiled models
  → How much do we care about this?
Excel Add-in Interface
Conclusion

• Signal propagation based models are more flexible, potentially more accurate

• Use of Excel Add-ins Enables:
  – Retain familiar user interface suitable for most users
  – May offer better trade-offs
  – May simplify the spreadsheet (eliminate unnecessary cells), artificial accounting for jitter
  – Possible to add arbitrarily complex device models
  – Possible to include various equalizer structures

• How do we proceed from here?