Enhanced Spreadsheet Model for 10Gb/s MMF Links

Petar Pepeljugoski, IBM Research,
Yorktown Heights, NY 10598
petarp@us.ibm.com
(914)-945-3761

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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

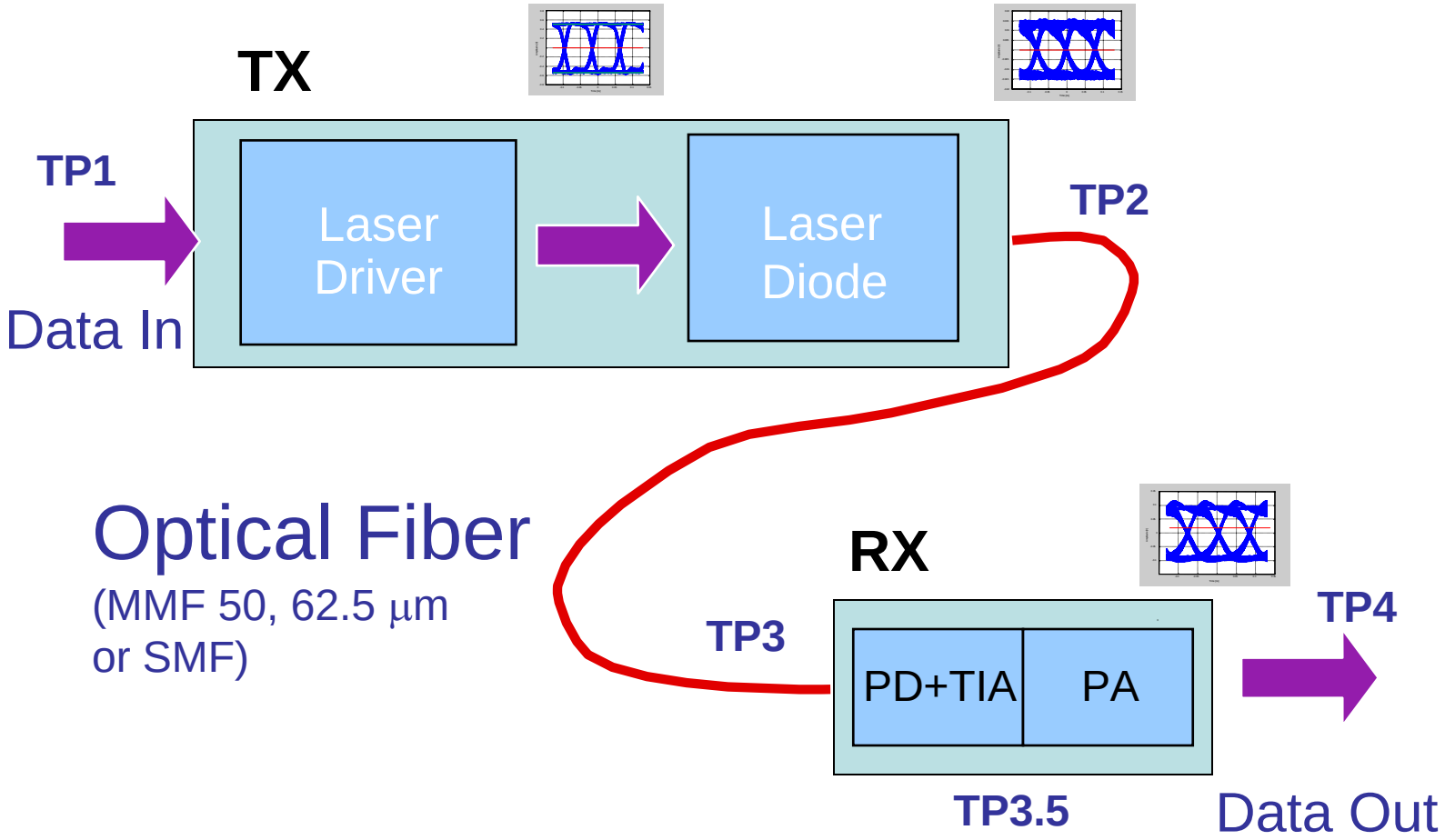
Why do we still use it?

- ✓ 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

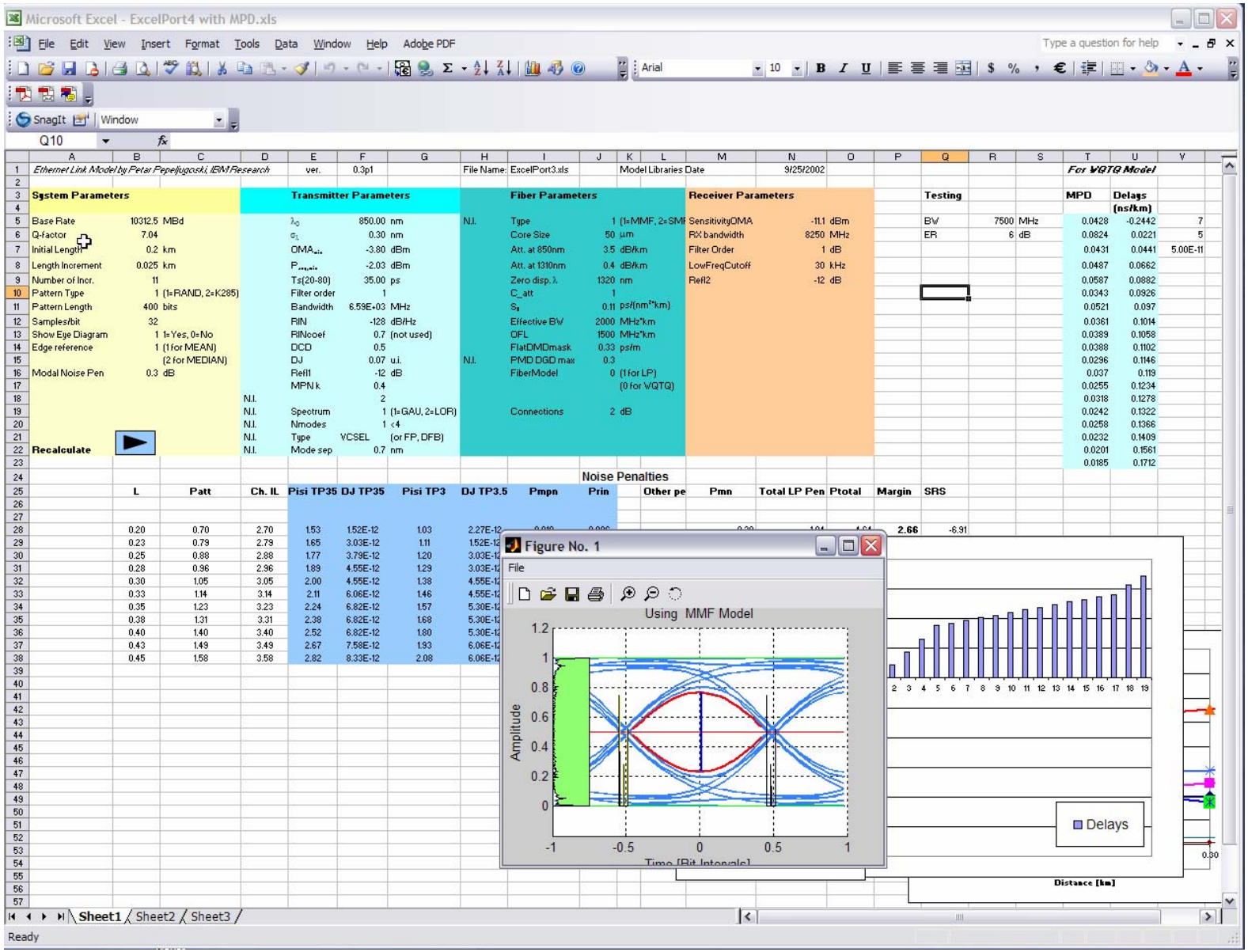


Excel Add-in

- 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?