

*Lightwave System
Modeling at the
Lightwave Communication Systems
Laboratory*

Information and Telecommunications
Technology Center
University of Kansas

Why Numerical Simulation

- Dispersion and fiber nonlinearities make analytical approaches nearly impossible
- Most effects can be included
- More cost-effective than experiments
- They are very useful tools for system design

Simulations Capabilities

- Dispersion and nonlinear effects in optical fiber links
- Evaluate the performance of TDM/WDM systems
- Compare different kinds of fibers
- Simulate different waveform transmissions
- Explore new system configurations

What effects are Included in Our Simulations ?

- Fiber loss and dispersion
- Fiber nonlinear effects:
 - * Self-phase modulation (SPM)
 - * Cross-phase modulation (XPM)
 - * Stimulated Raman Scattering (SRS)
 - * Four-wave mixing (FWM)
- Polarization mode dispersion (PMD)
- Spontaneous amplified emission (ASE)

Modeling Optical Fiber Links

- Modeling
 - * Two Parts: Numerical methods and component models
 - * Two Dimensions: TDM and WDM
 - * Two Models: Linear model and nonlinear model
- Model architecture
 - * Links (Point to Point)
 - * Fibers (SMF, DSF, DCF, etc.)
 - * Spans (EDFA Span)

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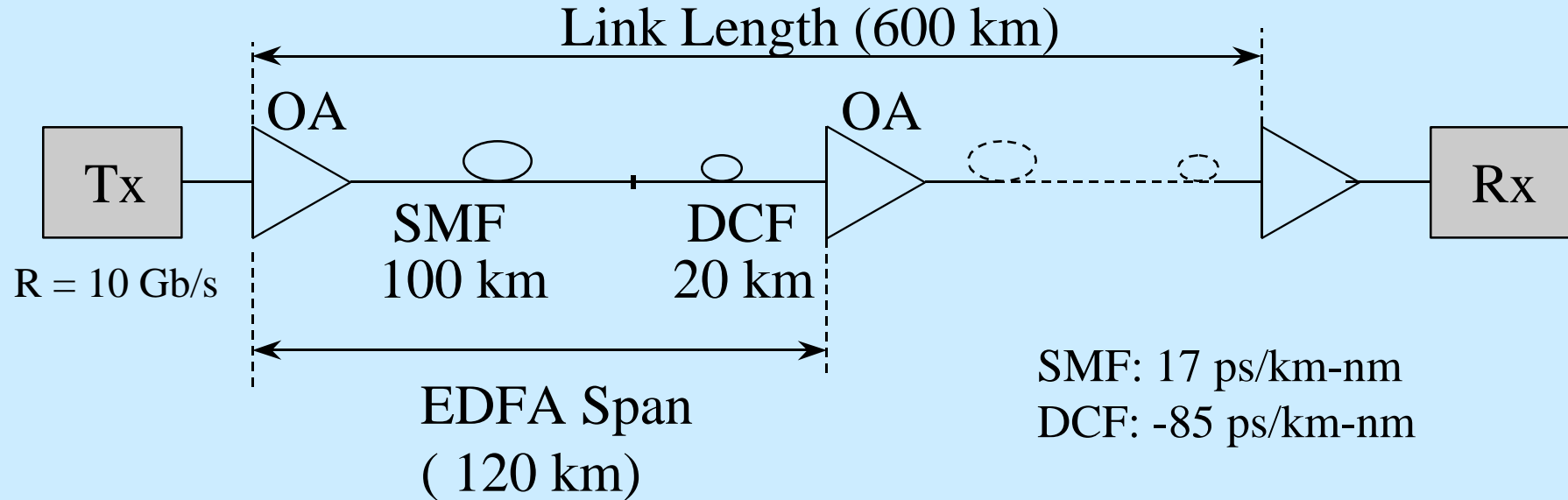
Simulation Results

- TDM system with two fiber types: SMF & DCF
- FWM effects in a two-channel WDM system
- Interaction between solitons and NRZ signals in WDM systems

A TDM System

to evaluate the dispersion compensation effect

- Two fiber types
Standard single mode fiber (SMF) and dispersion compensation fiber (DCF)
- Link structure



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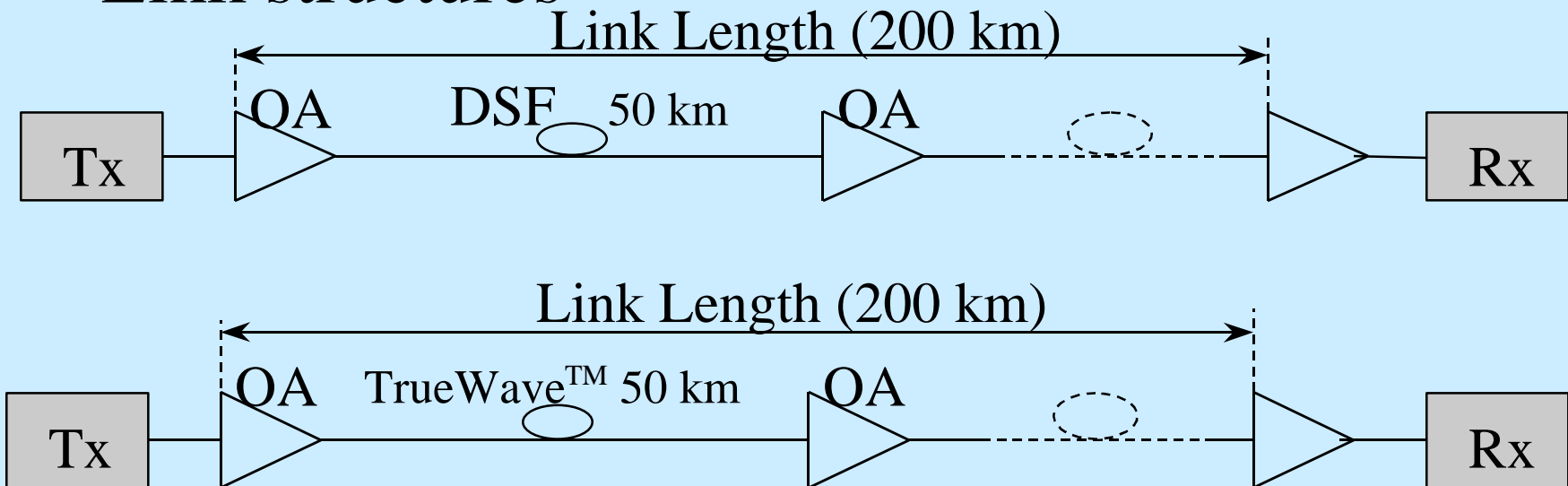
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A WDM System

to evaluate the four-wave mixing (FWM) effect

- Two links:
Dispersion-shifted fiber (DSF) and TrueWave™ fiber
- Link structures



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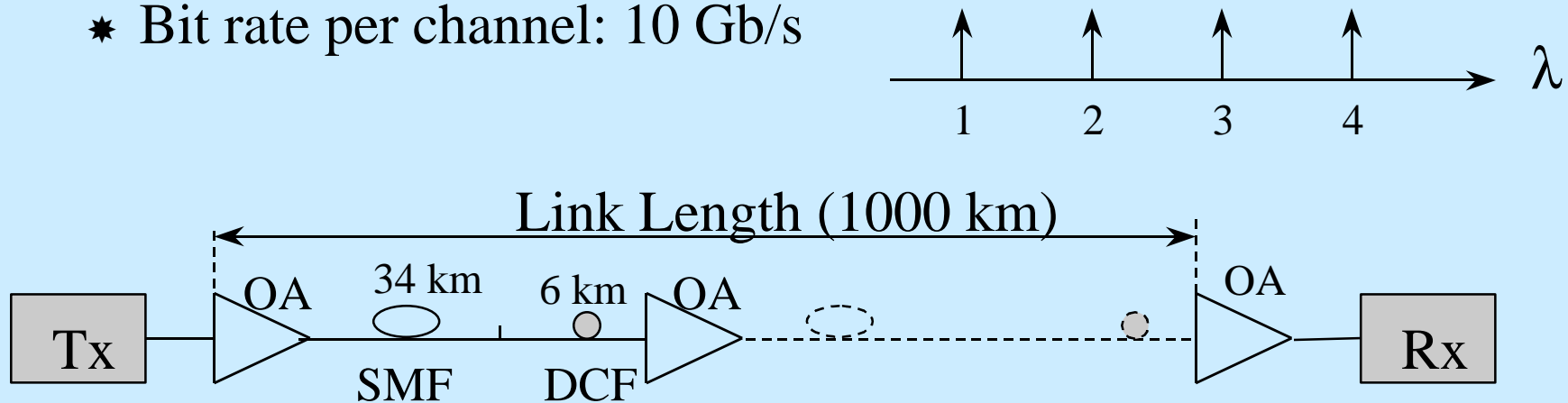
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Interaction between Solitons and NRZ Signals in WDM Systems

- Objective
 - ★ Study network transparency for different signal formats
- System Configurations
 - ★ Four-channel WDM: one soliton, three NRZ channels
 - ★ Channel spacing: 0.8 nm
 - ★ Bit rate per channel: 10 Gb/s



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Conclusions

- We have developed a powerful, comprehensive modeling tool for lightwave communication systems.
- This tool has proven valuable for diagnosing poor performance in systems under development.
- We intend to apply this modeling capability to address questions concerning networking evolution issues.