Lightwave Communications
Systems Research at the
University of Kansas

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The University of Kansas
Our Mission is to . . .

• Increase the capacity utilization of long distance lightwave communications networks;
• Train the next generation of engineers in the field of lightwave systems;
• Conduct research and publish results that contribute to the knowledge base in the lightwave arena;
• Provide value to local industry relating to the application of lightwave technologies;
• Establish and maintain a core competency in lightwave systems techniques.
The only state-of-the-art lightwave systems research laboratory in Kansas;

Supported by Sprint, Lucent Technologies, NEC Corporation, the National Science Foundation (NSF), and the Kansas Technologies Enterprise Corporation (KTEC);

Conducts research in a variety of areas including wavelength-division multiplexing (WDM), solitons, polarization-mode dispersion (PMD), photonic switching.
Laboratory Infrastructure

- Started Jan. ‘96 (20 months ago)
- 600 ft² laboratory space
- Key test equipment includes
  - 12 GHz BERT, Tunable Laser, 50 GHz Scope
  - Polarization Analyzer, Optical Spectrum Analyzer
- Lucent FT-2000 8-λ WDM system
- Ciena 16-λ WDM system
- Soliton generator (built at KU)
- Recirculating loop (built at KU)
- Optical Clock Recovery (under development)
Background

• Founded in Spring 1996
  Support: $2,033,118 (Total)
  NSF - $210 K/yr through ‘99
  KTEC - $135K/yr through ‘99
  Sprint, Lucent, NEC - $1M/yr through ‘99

• Its purpose is to:
  • Identify, characterize, develop, and recommend technologies that will expand the capabilities of the long-distance fiber networks
  • Evaluate the merits of new optical networking technologies
  • Promote university/industry interaction (NSF/KTEC)
Participants

• Faculty:
  Ken Demarest (WDM Systems, Solitons)
  Chris Allen (WDM and Coherent Systems)
  Victor Frost (ATM, SONET, Networking)
  Joseph Evans (ATM, SONET, Networking)
  Karen Nordheden (Devices)
  Rongqing Hui (WDM Systems, Devices)

• Postdoctoral Fellow:
  Coming in November

• Students:
  9 Graduate, 1 undergraduate
Major Results and Technology Transfer

- Modulator Patent Application
- Three Papers: Photonics Letters (2), JLT (1)
- Two Presentations Accepted for LEOS’97
  - Experimental Study of Four-Wave Mixing in Non-zero Dispersion Fiber
  - Interactions Between Solitons and NRZ Signals in WDM Networks
- Technical Reports
  - Modeling PMD In Optical Fiber Links
  - Service Survivability of Fiber Networks: Photonic Networks, SONET and ATM
  - Evaluation of WDM System in SMF and DSF
- Fiber link simulator delivered to Sprint
Current Research Areas

• High Speed Time-Division Multiplexing (TDM) and Solitons
• Optical Switching
• Modeling and Measurements
• Polarization Mode Dispersion
• Optical Networking
Soliton-based Transmission Systems

- **Goals:**
  1. Increase optical fiber transmission capacity.
  2. Soliton-transmission related all-optical switching and processing.

- **What we’ve done**
  - Built soliton generator
  - Assembled a recirculating loop
  - Demonstrated preliminary soliton transmission

- **What we’re planning to do**
  - Dispersion-managed soliton/WDM transmission
  - Soliton/NRZ hybrid transmission
  - Soliton all-optical switching
Optical Switching

• What we’ve done
  Reviewed technical literature of optical switches.
  Performed experiments with applications involving optical switching devices.

• What we’re planning to do
  Investigate clock recovery devices.
  Research space switches.
  Investigate optical switch applications in all-optical networks.
Modeling and Measurements

• What we’ve done
  • Developed high fidelity model for fiber transport
  • Applied model to address WDM over DSF issues raised by Sprint
  • Model has also been used by Sprint’s Network Planning group

• What we’re planning to do
  • Use this capability to address network issues
PMD Compensation

• What we’ve done
  • Investigate PMD compensation schemes

• What we’re planning to do
  • Develop an improved PMD compensator
Future Efforts

• Continue development of lightwave system model
• “Virtual transport networks”
  • optical and information transparency
  • survivability
• Bidirectional networks
• Continued hardware development of dispersion managed and soliton systems
• Explore optical switching technologies and all-optical clock recovery techniques