



# ***Ultra-Low Latency, All-Optical Label Switching Routers with Optical Label Swapping & Contention Resolution in Wavelength, Time, and Space Domains***

S. J. Ben Yoo

Optical Switching and Communications Systems Lab

UC Davis

[yoo@ece.ucdavis.edu](mailto:yoo@ece.ucdavis.edu)

***Data in the Optical Domain Workshop***

March 17, 2003

# *Example: 1.28 Tb/s routing system*

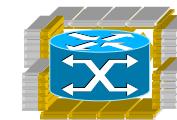


## Conventional System



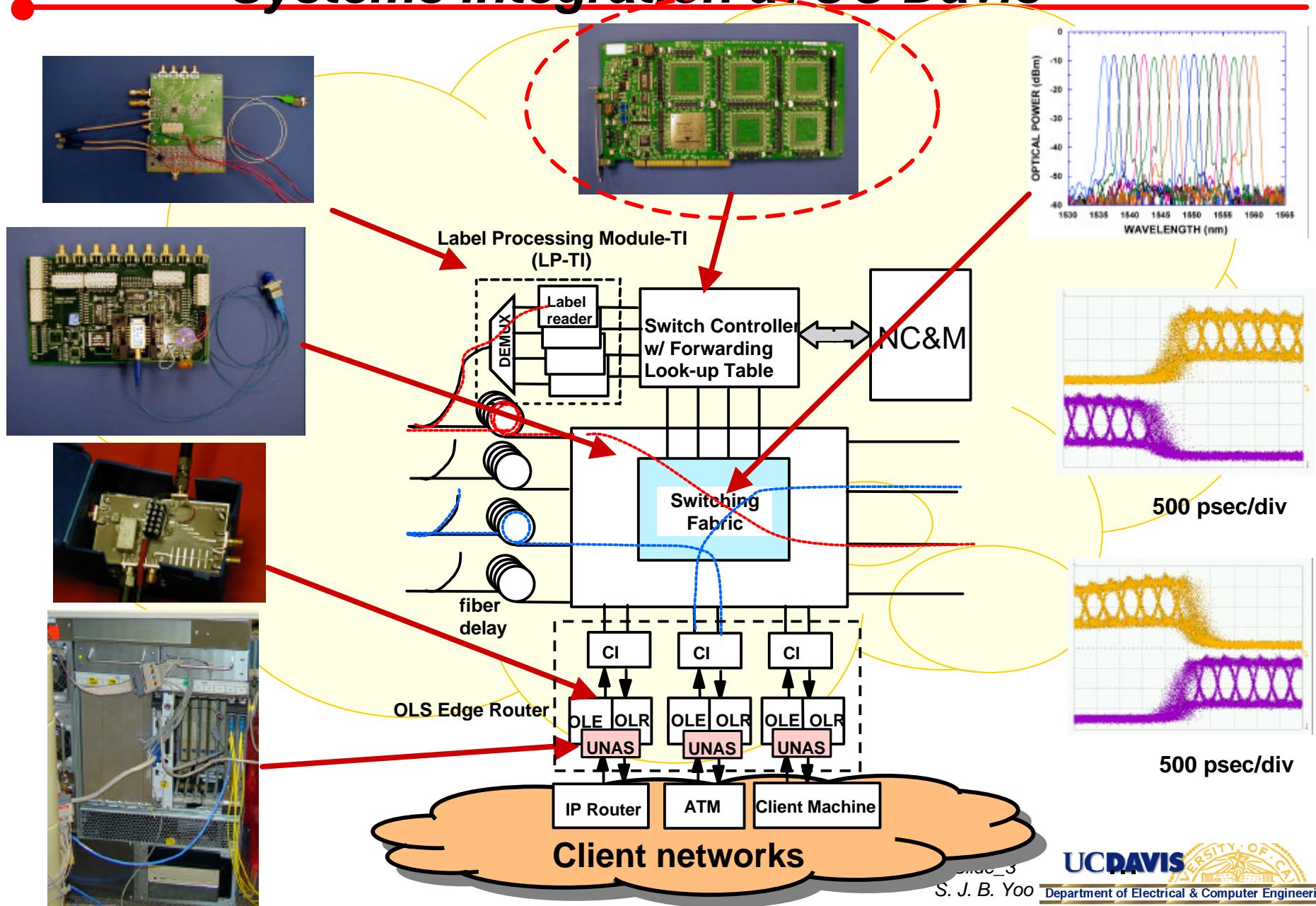
*Requires 16 Routers and  
16 sets of 16 Transponders at OC-192  
Size: 32 bays in standard 19 in. rack  
Power Consumption: ~200 kW  
Each Port Protocol Specific up to OC-192*

## All-Optical System

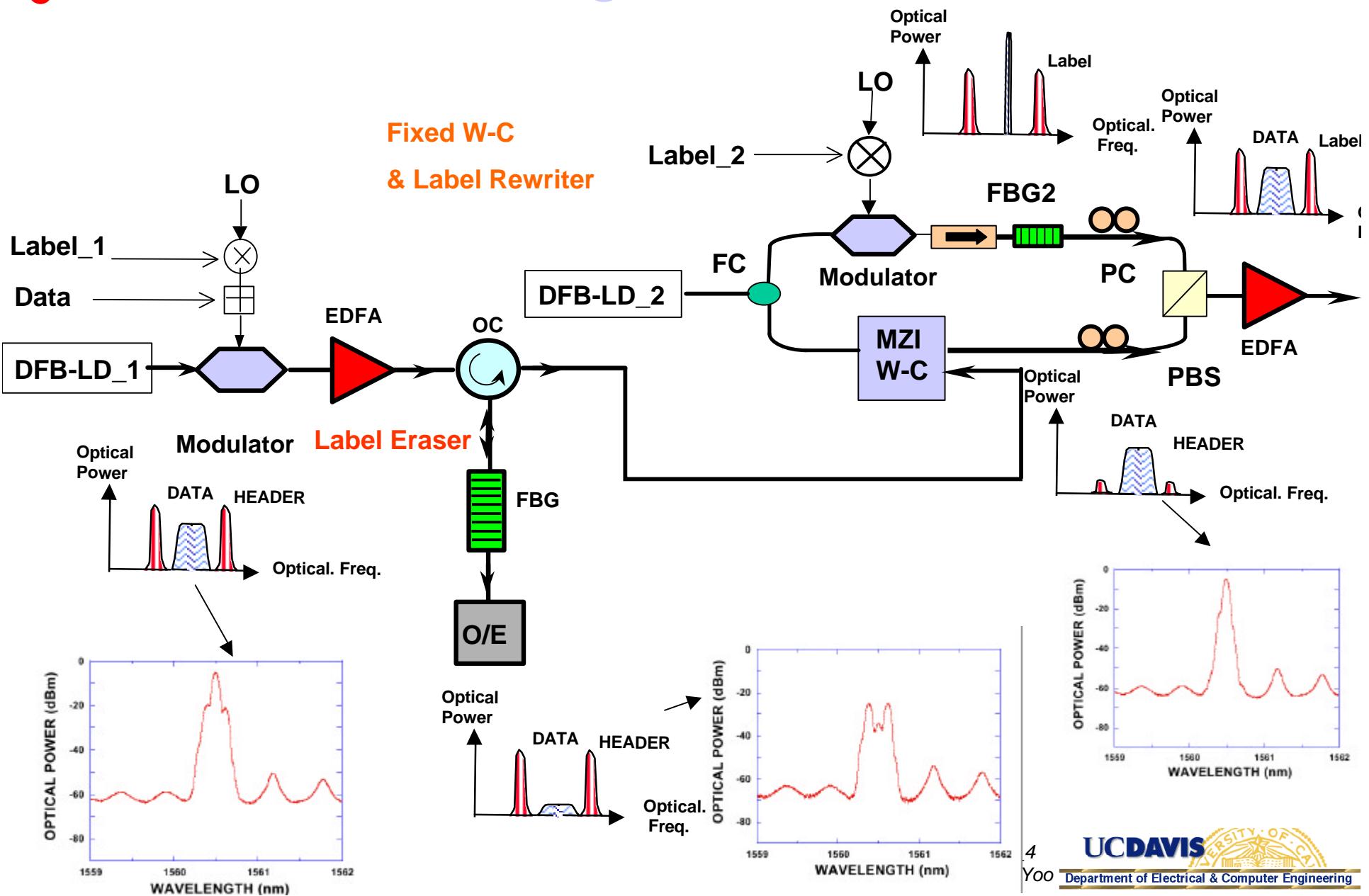


*One Box does All  
Size: 1 shelf in 1 bay in standard 19 in. rack  
Power Consumption: ~100 W  
Each Port Protocol Independent up to OC-768  
Can achieve Packet Switching and Circuit  
Switching*

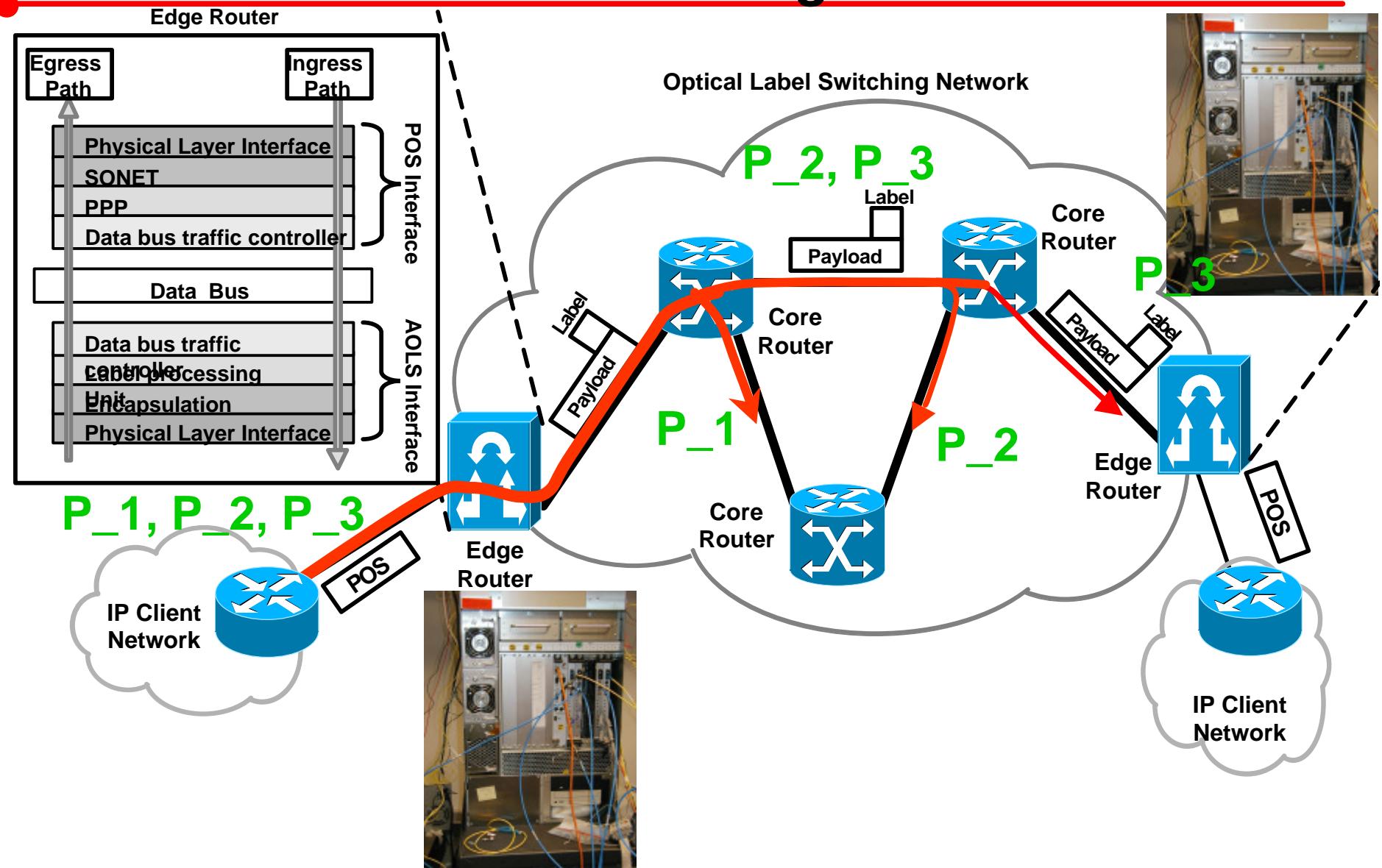
# All-Optical Label Switching Router Systems Integration at UC Davis



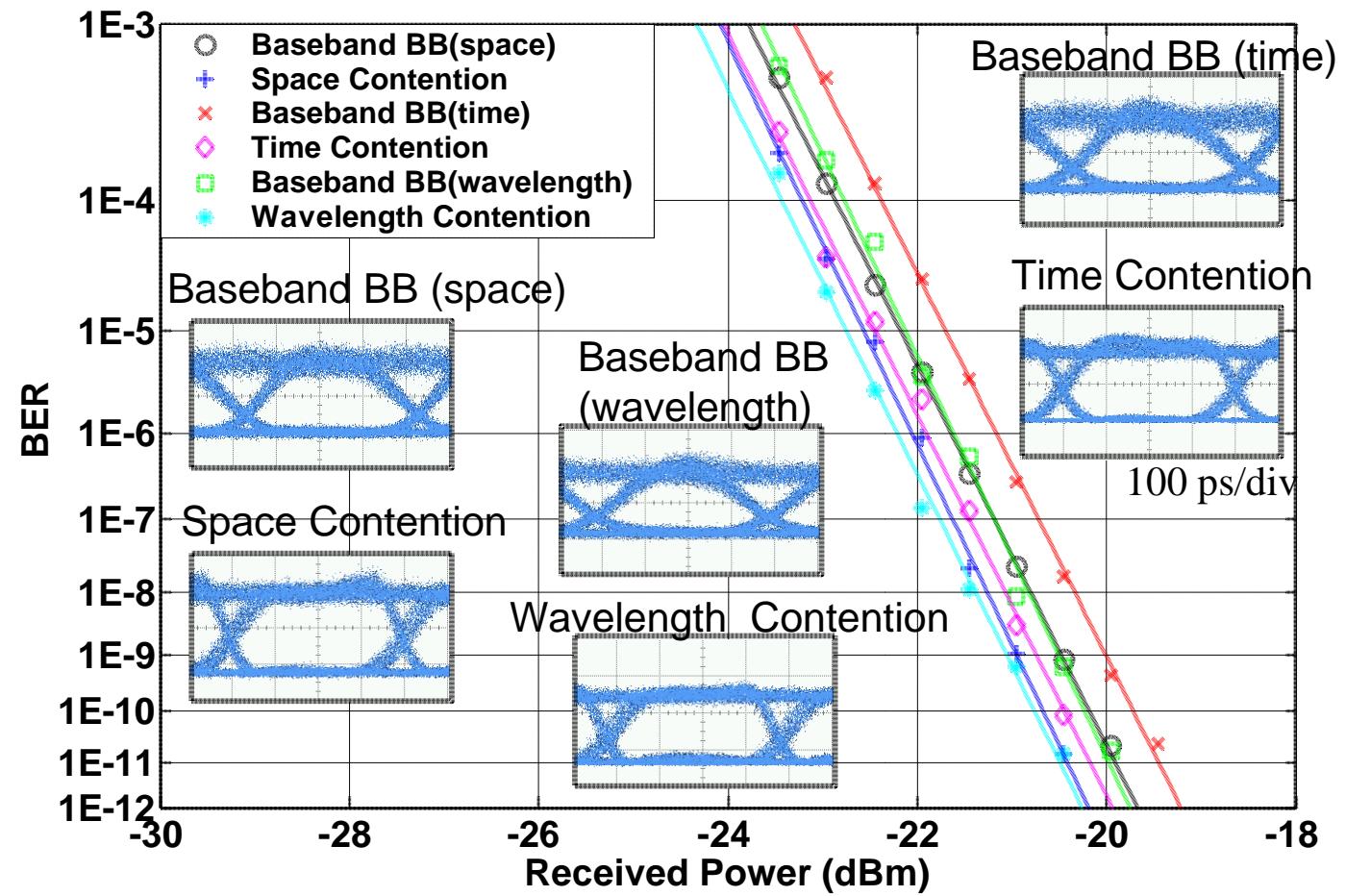
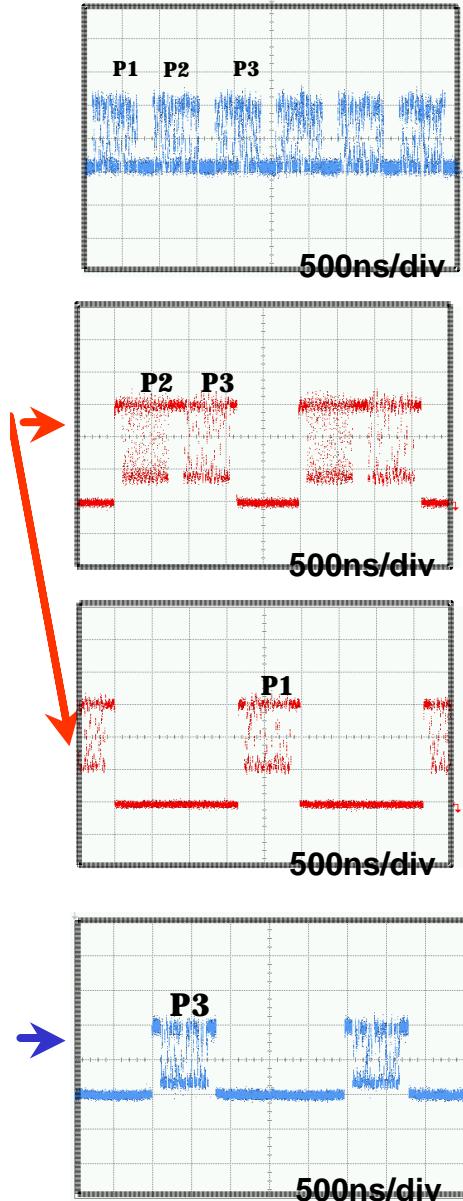
# All-Optical Label Swapping with Regeneration and Wavelength Conversion



# IP Client-to-IP Client packet transport over Cascaded OLSRs and Edge Routers



# BER for Packet-by-Packet Contention Resolution in Wavelength, Time and Space domains



# *Optical-Label Switching Router Summary*



- **Demonstrated Optical Router System with:**
  - All-Optical Label Swapping with 2R-Regen
  - 600 psec packet switching speed and 260 nsec latency
  - Scalable 42 Pb/sec,  $32^*(65536 \times 65536)$  switching capacity
  - **Wavelength, Time, Space** Contention Resolution without electronics or RAMs in the data plane
  - Variable size packets, asynch. operation for flexibility
  - Circuit, Burst, Flow, Packet Switching Interoperability
  - ~1% packet loss rate with single stage core router,
  - ~0.0001 % packet loss rate with additional intelligence
  - Cascaded OLS core and edge router demonstration
  - The first successful field trial over 477 km field fiber links in NTON/Sprint