WDM MPLS Testbed

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The Goal

A reconfigurable WDM MPLS Testbed based on Ethernet hardware
The Drivers

- Network Traffic is dominated by Internet traffic (burst in nature)
- A large fraction of Internet traffic is in Ethernet format
  - Ethernet technology is cheap!
- Explosive growth of end user bandwidth capability in Ethernet (GbE and 10GbE)
  - Access to fat pipe
  - Bandwidth on demand
- Efficient reconfigurable network
- Ethernet format has the lowest per bit bandwidth cost
- A testbed for studying network control and management intelligence
Key Issues for a Reconfigurable Network

- Intelligence
  - Electronic layer: Routing protocol (MPLS)
  - Optical layer: Wavelength routing

- Connectivity fabric
  - Electronic layer: Gigabit/Terabit router-switch
  - Optical layer: WDM OXC switch

- Network Architecture
  - Performance
  - Economics
  - Connectivity

Layer Two WDM LAN Implementation
Mapping Wavelength to Port
UMBC WDM LAN Testbed

WDM Interface (WDM-I)

EXC

1.3um multimode fiber
transponder
WDM laser array

1.5um single mode fiber

Full Duplex

Full Duplex or half duplex
Depends on WDM user

No distance limitation (except power budget)

Traditional way, needs no modification of current LAN

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LTS Review 2001 p7

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LTS Review 2001 p8
WDM Reconfigurable \(\text{MP}\lambda\text{S Testbed}\)

Network Topologies

- **Network 1**: 2 nodes, 8 users, 1 link
- **Network 2**: 3 nodes, 8 users, 2 links
- **Network 3**: 3 nodes, 6 users, 3 links
- **Network 4**: 4 nodes, 8 users, 4 links
- **Network 5**: 5 nodes, 12 users, 4 links
- **Network 6**: 6 nodes, 14 users, 5 links
- **Network 7**: 8 nodes, 18 users, 7 links
- **Network 8**: 9 nodes, 18 users, 9 links
- **Network 9**: 8 nodes, 12 users, 10 links
- **Network 10**: 12 nodes, 16 users, 16 links
MPλS Testbed Architecture

Blocking Probability Comparison (8λ)
Power budget for the WDM MP λS System (1Gbps data rate)

\[ 3\text{dBm} - [(x + (4+2)n) > -17\text{dBm}] \]

- \( x \): loss of AWG
- \( n \): the maximum stage number without EDFA

<table>
<thead>
<tr>
<th>( x )</th>
<th>( n )</th>
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<tbody>
<tr>
<td>5dB</td>
<td>1</td>
</tr>
<tr>
<td>2dB</td>
<td>2</td>
</tr>
<tr>
<td>1dB</td>
<td>3</td>
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Edge Node Architecture

- Current PC
- 2 Gbps bi-directional bandwidth
- 6 available slots (ports)

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LTS Review 2001 p13

LTS Review 2001 p14
Core Node Architecture

Component Requirement List

<table>
<thead>
<tr>
<th>Component</th>
<th>Units</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Routers (LSR/ LER)</td>
<td>9</td>
<td></td>
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<tr>
<td>Gigabit Electronic Switch</td>
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<tr>
<td>Transponder (1Gbps)</td>
<td>36</td>
<td></td>
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<tr>
<td>6 x 6 Optical switch</td>
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<td></td>
</tr>
<tr>
<td>EDFA</td>
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<tr>
<td>WDM Laser Array</td>
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<tr>
<td>AWG</td>
<td>60</td>
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<tr>
<td>Gigabit NIC</td>
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Near Term Objectives

- Enable a reconfigurable WDM MPLS network
- Reuse the λ path
- Request/Setup/Delete λ through Traffic Engineering (TE) (BC/CP)
- Alternative Routing Selection (BC/CP)
- Protection (UMBC)
- Traffic Monitoring (UMCP)
- Traffic Engineering (UMCP)