Network Cost Savings and Service Differentiation using Priority-driven sub-50ms Shared Mesh Protection

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**Resiliency Requirements for Today’s Networks**

**Optical Networks are now mesh-centric**

<table>
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<th><strong>Fast Recovery</strong></th>
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**DWDM Networks**

- 1+1 SNCP Protection
  - <50 ms switching
  - Protection for 1 failure
  - Dedicated protection bandwidth ($$$$)

**Optical Cross-Connect Switches**

- Dynamic Re-routing
  - Variable performance
  - Multiple failure protection
  - Recovery via unused bandwidth lowering cost
Hardware-accelerated Fast Shared Mesh Protection

Deterministic sub-50ms Protection*

**Fast Recovery**
- Deterministic behavior, within 50 milliseconds

**Multi-failure backups**
- Single failure recovery no longer sufficient

**Network Efficiency**
- Intelligent sharing of backup resources without losing availability

- Emerging ITU standards
  - G.808.3 & G.ODUSMP
- Logical protection paths
  - “Virtual” until activated
- Fast activation of protection path
  - Hardware acceleration

Provides the advantages of:
- Deterministic, sub-50 ms performance
- Multiple failure protection
- Shared protection bandwidth for Better network economics

*W. Wauford et al, ECOC -2013: Novel design of G. ODUSMP to achieve sub-50 ms performance with shared mesh protection in carrier networks*
Shared Mesh Protection (SMP)

Method Of Operation

1. LINK FAILURE
2. DATA-PATH FAILURE NOTIFICATION
3. SMP PATH ACTIVATION

Sharing of Bandwidth Among Protection Paths

Working Path (High Priority Service)
SMP Path (High Priority Service)
SMP Path (Low Priority Service)
Working Path (Low Priority Service)
Shared Mesh Protection (SMP)

Service Differentiation with Pre-emption

Msg #7 is only additional message required for pre-emption. Cross-connect over-ride only, no additional time for protection path activation. Pre-emption of ‘Extra traffic’ follows same mechanisms.

Sharing of Bandwidth Among Protect Paths
Simulation Scenario

Objective: Evaluate Network Cost Savings with SMP using Service Differentiation

Pan-USA Network

- Traffic Client Rate:
  - Mix of 10G, 40G, 100G Clients
  - Mix of Data Center, Transcontinental, city-to-city traffic
- 50% High Priority and 50% Low Priority Traffic
- 100G DWDM with real-world deployment rules

Topology Details

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td># Links</td>
<td>114</td>
</tr>
<tr>
<td>Average Node Degree</td>
<td>2.62</td>
</tr>
<tr>
<td>Max Node Degree</td>
<td>5</td>
</tr>
<tr>
<td>Average Link Distance</td>
<td>375 Km</td>
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Traffic Details

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<tbody>
<tr>
<td></td>
<td>Data Center, National &amp; International Traffic</td>
</tr>
<tr>
<td>Phase 1 Traffic (Tb/s)</td>
<td>6.93</td>
</tr>
<tr>
<td>Phase 2 Traffic (Tb/s)</td>
<td>10.02</td>
</tr>
<tr>
<td>Phase 3 Traffic (Tb/s)</td>
<td>24.95</td>
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Economics of Deploying Different Protection Schemes

- All SMP mechanisms use significantly lower number of modules compared to 1+1 protection.
- With 10% Additional Line Modules compared to zero-protection scenario, strict SLAs are guaranteed for 50% of traffic (high priority).
Failure Detection Time and Service Recovery Time

- Impacted Demands satisfy sub-50ms recovery time
- Recovery time does not change with number of Impacted Demands

*Recovery Time Computed using CSIM integrated with Planning Tool*
Summary

- Fast Shared Mesh Protection with service priority opens up new possibilities
  - High savings by sharing of resources
  - Low cost network while ensuring strict SLAs (sub-50ms recovery) for high priority traffic only
  - Further savings by pre-emption of ‘Extra Traffic’

- Pre-emption of extra traffic/protection traffic has no impact on recovery time
  - Recovery time does not depend on number of impacted demands
  - Pre-emption enables protection prioritization in multiple-failure scenarios
Thank You