Synergies Between Optical and Packet Rings

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Motivations for Optical Rings

*** Limitations and restrictions of TDM rings**

- TDM channels difficult to scale beyond 10 Gb/s
 Non-transparency limitations (mappings required)
- Complex, lengthy service provisioning procedures

*** Architectural significance of rings will remain**

- Ring fiber plants will dominate many spaces: Access, metro, regional, even back-bone
- Ubiquitous fast protection switching concepts
- Extensive deployment and experience (TDM rings)
- Strong operator interest in optical rings



Motivations For Optical Rings

"Mesh Over Rings"



Optical Rings Overview

*** Extend existing TDM ring concepts**

- Still a "circuit-switching" paradigm
- Wavelength path replaces TDM timeslot channel
- Optical add-drop multiplexer (O-ADM) nodes: Wavelength bypass, add, drop, protection stages
- Translucent (O-E) or transparent O-ADM designs: In-band or out-band signaling/monitoring

¥ Various protection concepts researched
 > Optical channel (OCh) UPSR schemes
 > Optical multiplex section (OMS) BLSR schemes
 > Optical channel (OCh) BPSR schemes



Dynamic Provisioning Framework

Emerging "GMPLS-based" control

MPLS "mesh" origins, early focus on "long-haul mesh"
 CR-LDP/RSVP-TE for path setup signaling
 Augmented IGP's for information dissemination
 New "UNI" definitions (O-UNI, ODSI, etc)

Hust extend framework to cover rings

 Provide single, unified framework/architecture
 Require careful provisions in each (above) areas
 No considerations for "APS-like" signaling yet
 First, initial discussions in draft submission: N. Ghani, et al, draft-ghani-optical-rings-01.txt



Dynamic Provisioning Framework

Setup signaling considerations:

O-UNI (or other) "attributes" mappings
 CR-LDP/RSVP-TE (channel setup considerations?)
 Multi-domain ring provisioning (NNI implications?)

Resource and state information dissemination

Many provisions already (fiber/node, connectivity, SRLG)
Other additions for optical rings (opaque LSA's?)

Protection signaling requirements (BLSR/BPSR)

- Fast messaging, guaranteed latency required (50 ms)
- Added considerations for "operation modes"
- Extend LSP recovery or new packetized "APS" protocol



Dynamic Provisioning Framework

Additional considerations possible

- Multi-layer (protection) escalation strategies: Inter-layer (level) hold-off or signaling needed
- Mesh-ring interworkings:
 - Overlay: Leverage for mesh ("virtual rings")
 - Hybrid: Inter-topology provisioning (for migration)
 - D. Guo, et al, draft-guo-mesh-ring-optical-01.txt
 - D. Papadimitriou, draft-papadimitriou-optical-rings-00.txt

Synergies with resilient packet rings (RPR)



Comparison of Features

Category	Packet Rings	Optical Rings
Transport	Ethernet	SONET/SDH, D.W., GbE
Provisioning	LSP	OCh (lightpath channel)
Signaling	LSP	OCh (lightpath channel)
Protection	LSP/ (line?)	OCh/OMS (channel/fiber)



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Architectural similarities

- Protection schemes:
 - Packet rings: wrapping and/or (source) steering
 - Optical rings: loopback, ring switching, span switching
- Protection signaling (IPS/O-APS protocols):
 - Packet protocols, transport scheme may vary
 - Considerations for hard and soft failures
 - Many details similar (state machine, messaging, etc)
- Channel signaling issues
 - Use explicit routing capability
 - Constraint-based path computations



Packet/Optical Ring Interconnection: "WAN Packet Rings"



Protection escalation/coordination strategies

- Prevent IPS/O-APS collisions (more efficient)
 - Likely requirement for both to be under 50 ms
- Upstream fault coordination issues
- Note: not specific to just optical rings

*** Optical UNI interfacing**

- Router hosts multiple RPR's (given WDM ports)
- Diversity requirements for RPR hops

Recommendations/proposals

- Expand focus to investigate joint-areas
- We welcome further interest and joint work



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- **B** D. Guo, et al, "Hybrid Mesh-Ring Optical Networks and Their Routing Information Distribution Using Opaque LSA," Internet Draft, draft-guo-opticalmesh-ring-01.txt, March 2001.
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- **M.** Cvijetic, T. Shiragaki, A. Weissberger, "OCh Shared Protection Ring," *T1X1 Forum, T1X1.5/99-178*, July 1999.
- **M.** Soulliere, "Proposed ITU-T Contribution on Transparent OCh SPrings," *T1X1 Forum*, T1X1.5/2001-027, January 2001.
- **P.** Arijs, et al, "Design of Ring and Mesh Based WDM Transport Networks," *Optical Networks*, July 2000.



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