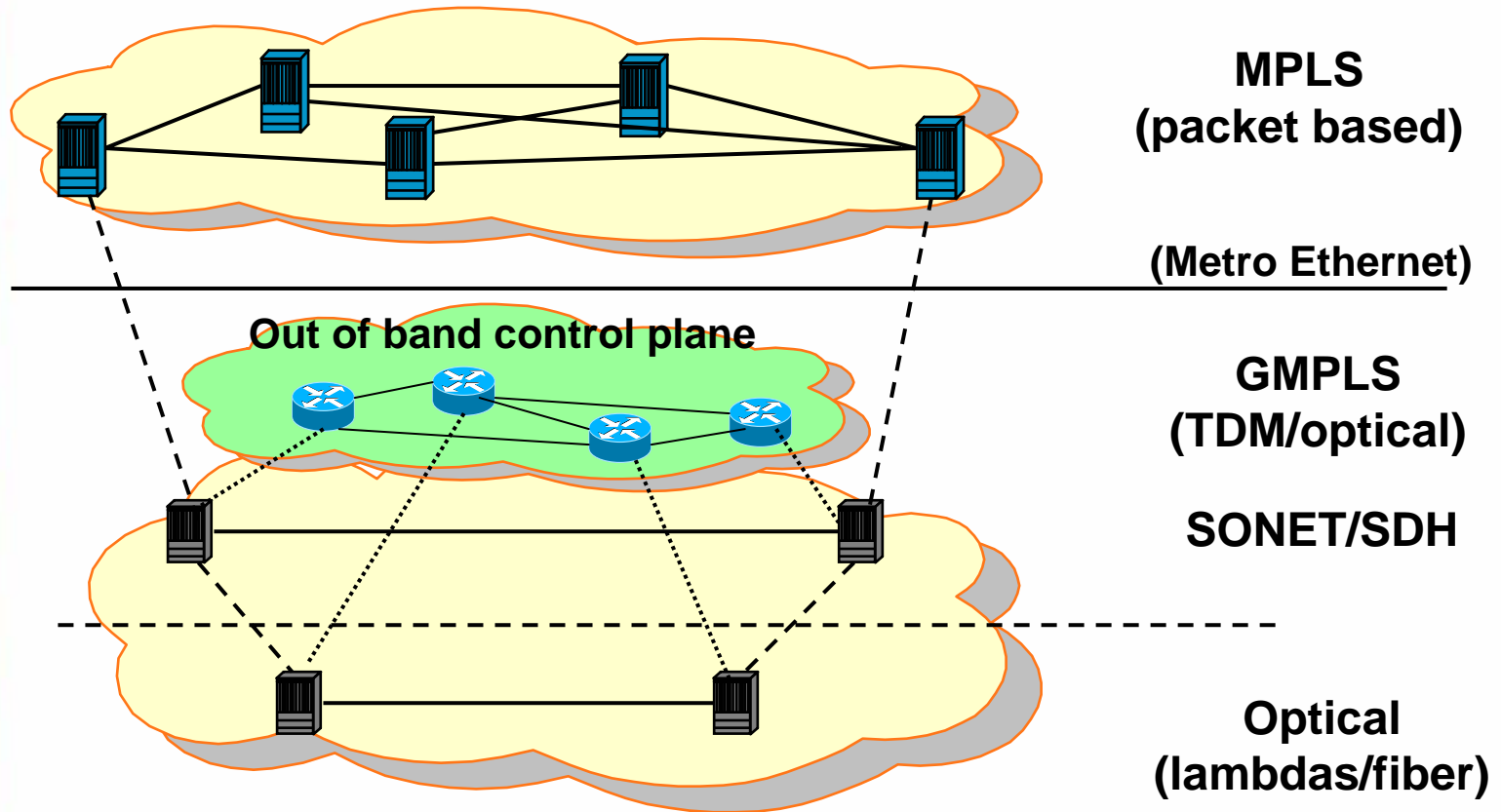


NETPLANE

**CONTROL PLANE SOFTWARE
FOR NEXT GENERATION NETWORKS**

High Availability In
MPLS/GMPLS Networks

MPLS/GMPLS Network Relationships



High Availability Requirements

- **50 ms switchover time**
 - Current standards for Telecom networks
- **Failure “hierarchy”**
 - Layer 1 and 2 faster restoration than layer 3
 - Transparency
 - Depends on facilities and topology
- **Current capabilities**
 - SONET/SDH APS < 50 ms
 - Link bundling < 45 ms
 - MPLS fast re-route < 45 ms
 - MPLS LER re-signaling < 7s
 - IP re-routing < 7s

Target Five 9's Of Voice Network

Implementation Options

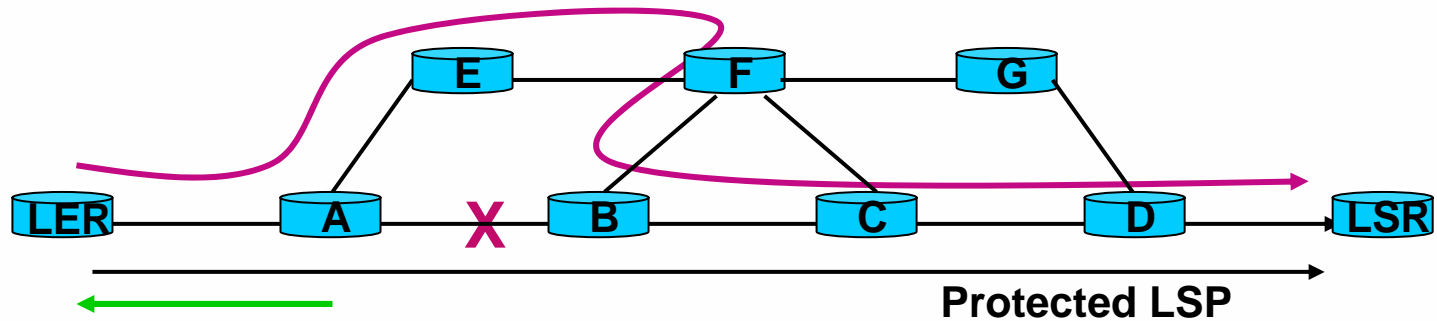
- **Internal capabilities**
 - Hardware/software redundancy
 - Architecture distribution
- **Control plane resiliency**
 - Routing stability – e.g. graceful re-start
 - Signaling flexibility
- **Network resiliency**
 - Protection and restoration schemes
 - 1:1 APS like
 - n:1 $n \geq 1$ – traffic engineering implications
 - Re-signaling
 - Control plane interaction
 - Secondary LSP pre-computed
 - Secondary LSP pre-computed and signaled
 - Fast reroute – multiple points of repair
 - Fault detection at Layer 1 or 2, routing (IGP), or signaling (RSVP-TE)

Today's
Focus



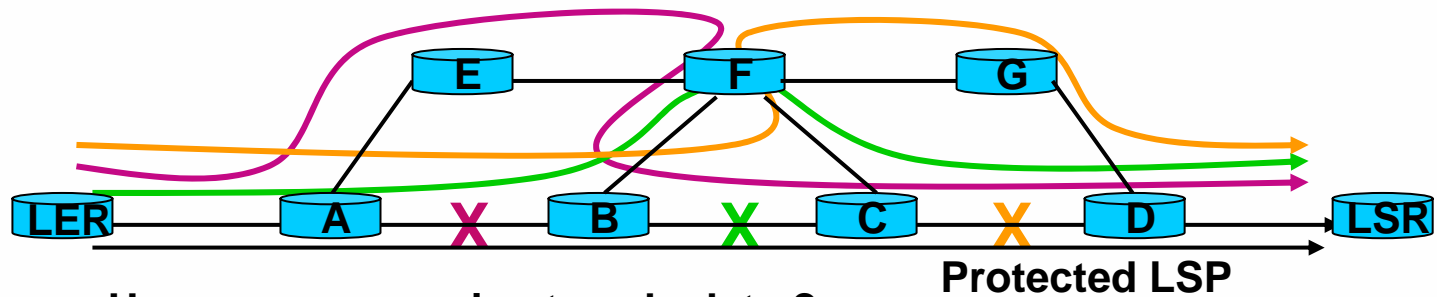
Fast Reroute Challenges

- Re-route from ingress (required for CR-LDP)



- Detect failure, notify ingress, re-calculate, signal new LSP
- Difficult to meet 50ms requirements

- Pre-compute backup LSPs



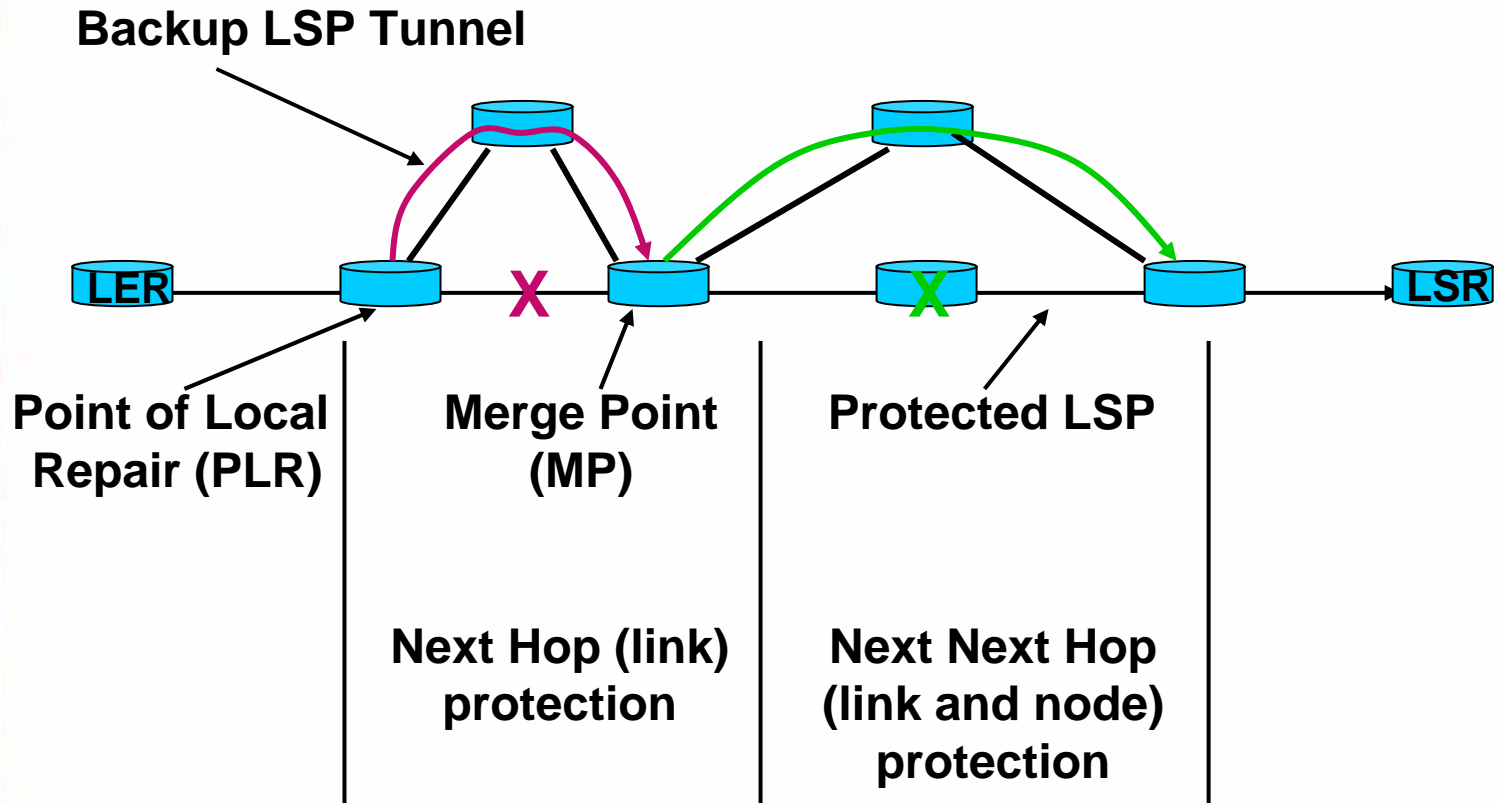
- How many scenarios to calculate ?
- Consumes enormous resources (network and state)

Requires Flexible Local Repair Mechanisms

GMPLS and MPLS Status

- **GMPLS**
 - Optical applications generally end-to-end
 - Functional specification stage
 - ITU, OIF and IETF CCAMP standards bodies
 - Mapping to ASON/ASTN models
 - Out-of-band control plane increases complexity
 - Consensus emerging on use of GMPLS notify object
- **MPLS**
 - Packet mechanisms have flexibility (IP, metro Ethernet)
 - IETF MPLS working group driven
 - Original ideas from Cisco, Juniper and Avici
 - Consolidated fast reroute draft
 - [Draft-ietf-mpls-rsvp-fastreroute-00.txt](#)

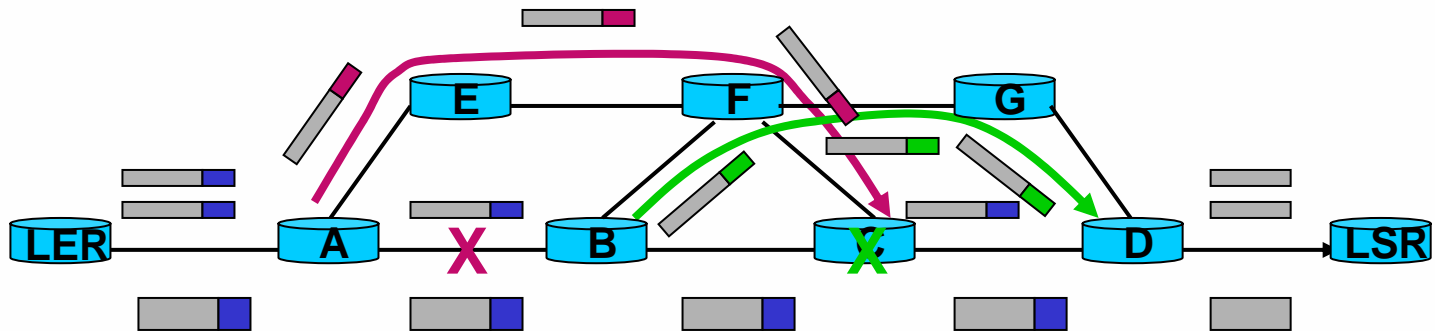
Fast Reroute Concepts



- 1:1 backup – detour LSPs
- N:1 backup – bypass tunnels (facility backup)

Traffic Engineering and RSVP-TE

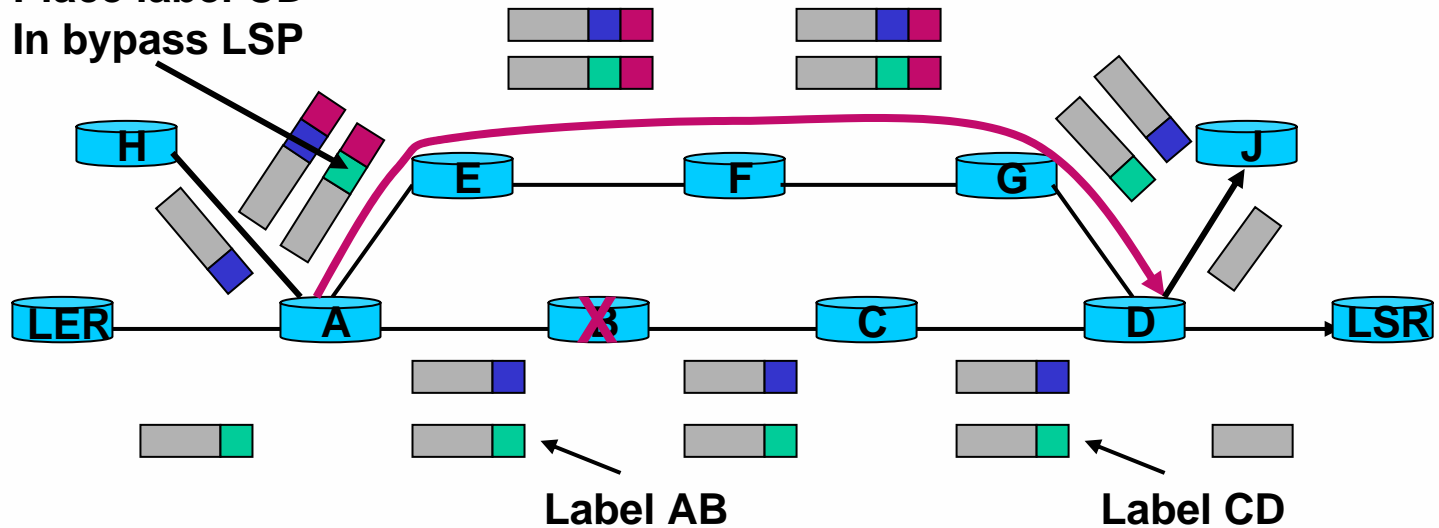
Detour LSPs



- 1:1 backup at any point on protected LSP
 - Up to n-1 backups
- Preserves explicit route characteristics
 - Network resources must be reserved
 - State information must be saved
- Switchover time can be immediate on failure detection
 - Holdover priorities optional

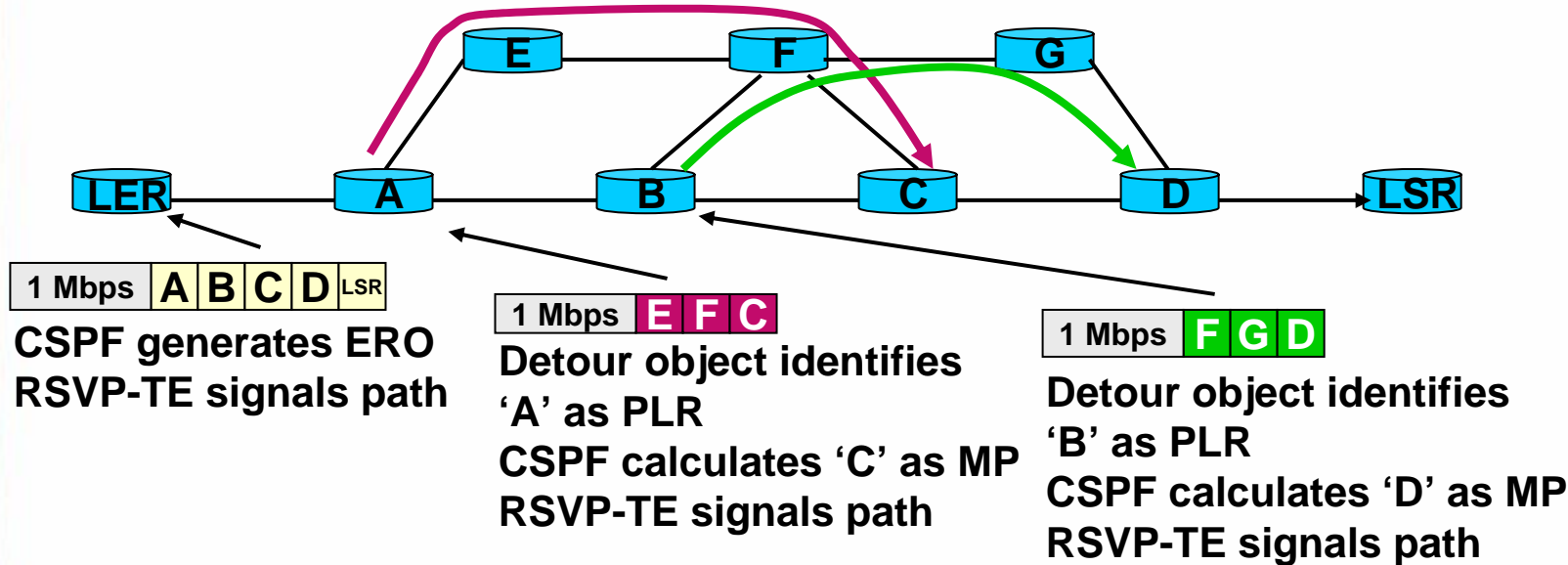
Bypass LSPs

Place label CD
In bypass LSP



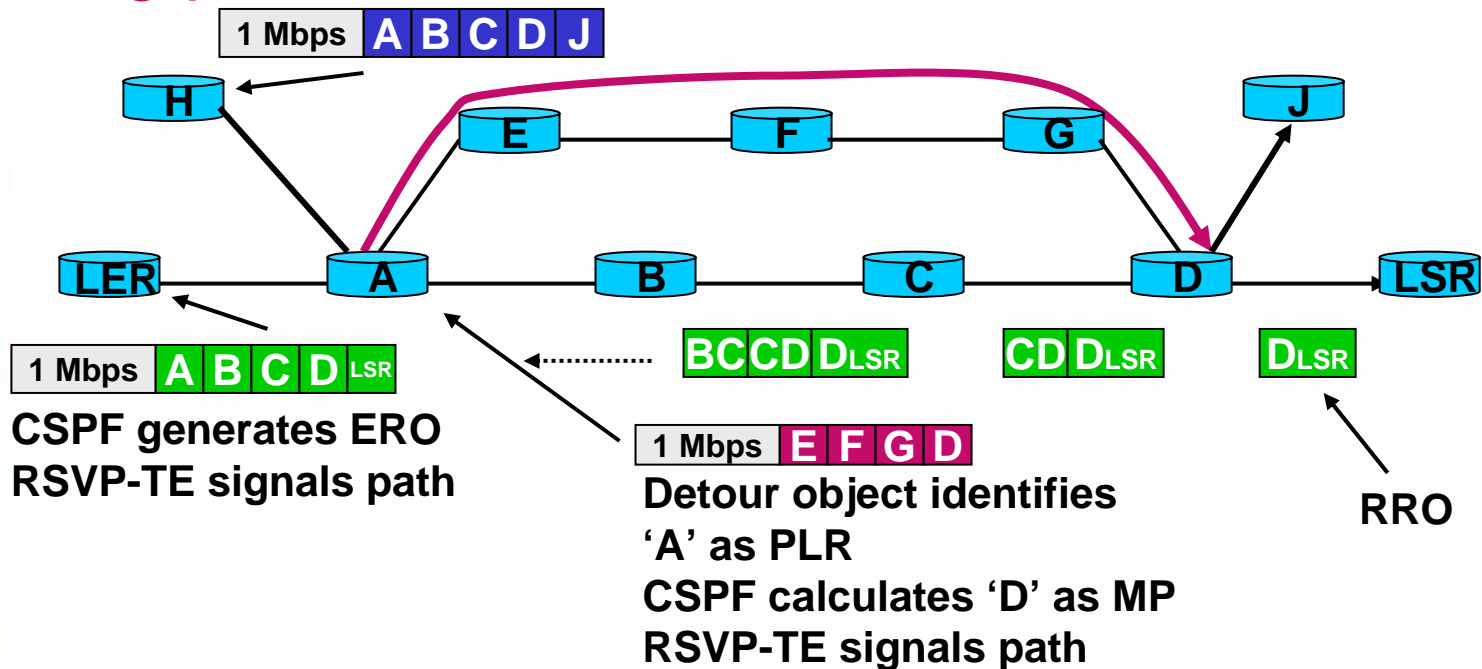
- Multiple LSPs can be backed up
 - Traffic constraints overbooked
- Protected LSP label management
 - PLR needs to learn MP label
 - Platform wide labels strongly suggested
- Switchover constraints same as for detour

Detour Path Calculation



- **CSPF can support disjoint paths**
 - Enables support for Shared Risk Link Groups (SLRGs)
 - Requires knowledge of lower layer transport
- **New PATH message objects**
 - Fast reroute – identifies protected LSPs and attributes – priority, hold time etc.
 - Detour object identifies PLR and any restrictions

Bypass Path Calculation



- Facility backup identified in Fast reroute object
 - However, generally manually provisioned
- One LSP selected as control for merged LSPs
- All messages (path, resv) directed over bypass tunnel
- Supports bandwidth over-subscription (with limits)
- Record Route Object to correlate labels
 - A learns CD is label between C and D (MP)

Path Restoration

- After local repair, LSP routing may be sub-optimal
- After failure detected
 - Error message/code returned to ingress
 - IGP routing update will occur
 - Order of seconds to update
- Re-computation of TE tunnel(s)
 - Policy determines long term repair and optimization scenario
 - Hold over on backup for primary path recovery

Time Sensitivity Removed

Summary

- **Protection and restoration key issues for MPLS/GMPLS acceptance**
 - **GMPLS and optical requirements evolving**
 - **MPLS fast reroute understood and implemented**
- **Two main fast reroute mechanisms**
 - **Detour LSPs – single LSP protection**
 - **Bypass tunnels – supports multiple LSPs**
 - **Mechanisms can be co-resident**
- **MPLS/GMPLS driving towards carrier-class characteristics**
 - **Five 9's operation or better becoming a reality**

Application At All Network Layers



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Thank You
Q&A

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