Availability and Performance Challenges in P2MP MPLS

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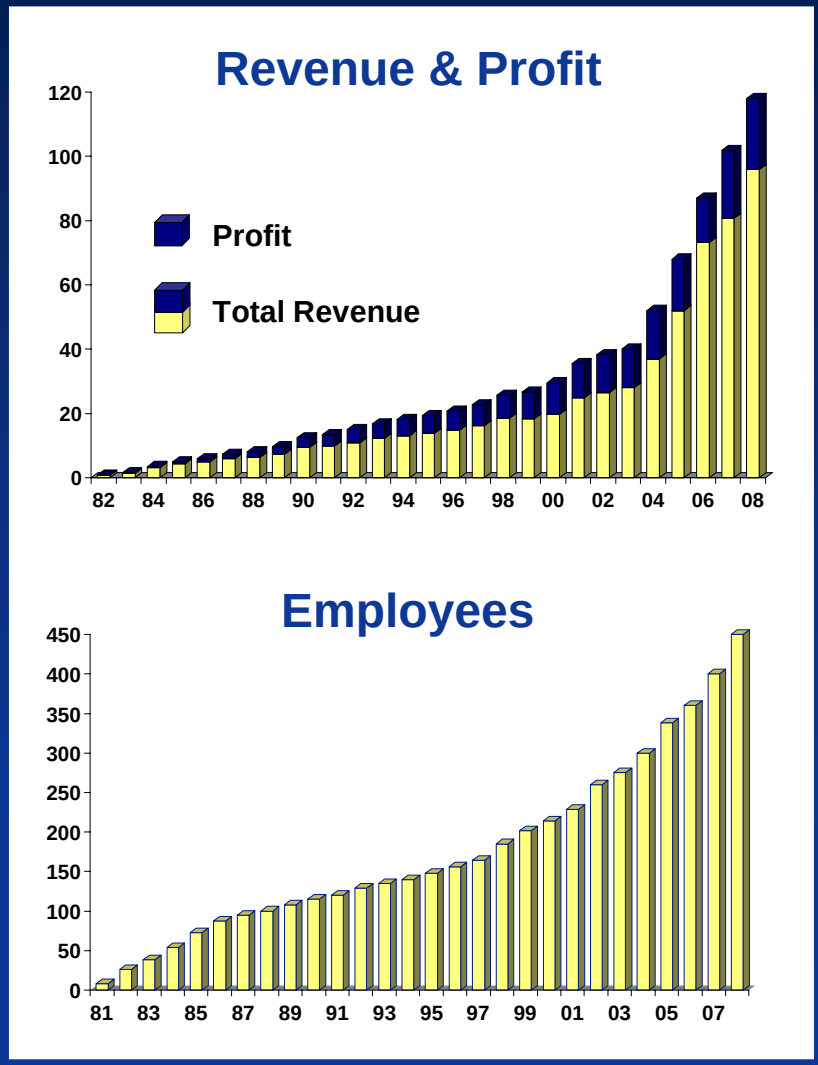
DATA CONNECTION

Data Connection (DCL) Overview

- **Background**
  - Founded in 1981
  - Headquarters in Enfield, UK
  - Approaching 500 employees
    - Predominantly R&D
- **2 Divisions**
  - **Network Protocols**
  - MetaSwitch
- **Success Factors**
  - Highest quality
  - Superior support
  - Engineering excellence
  - Supplier stability, longevity



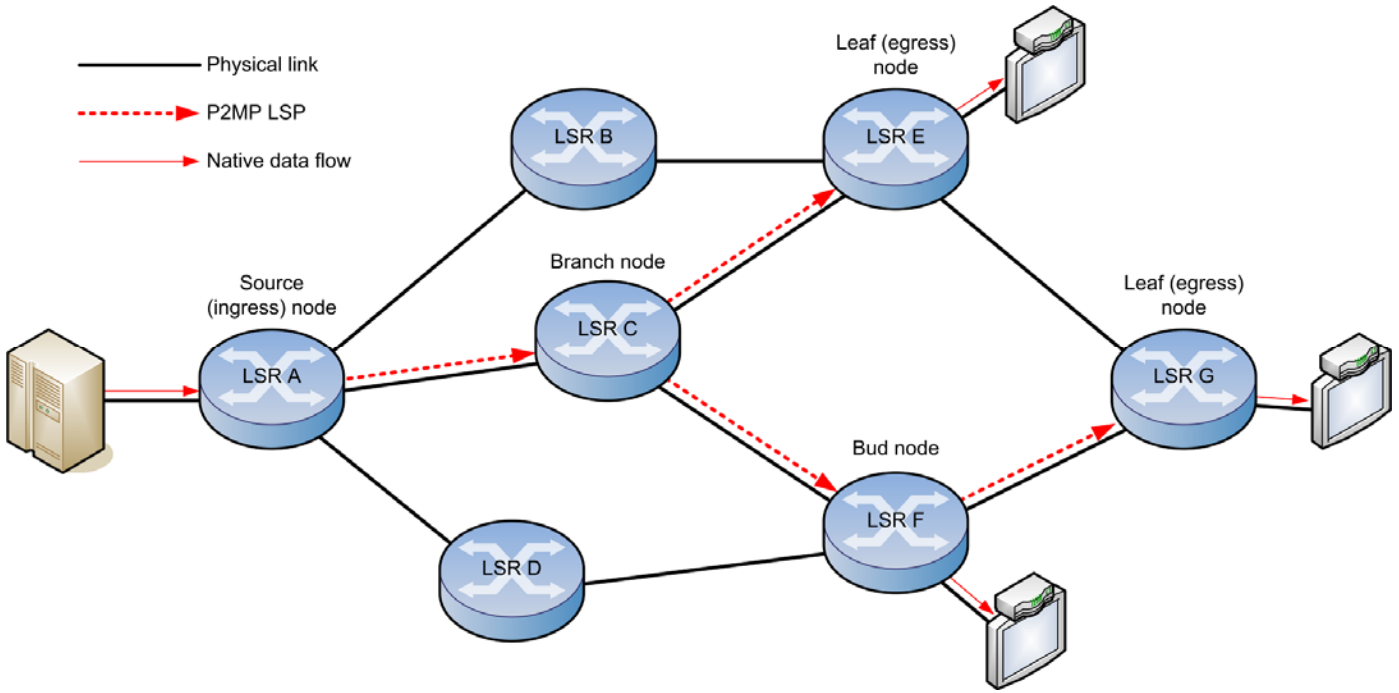
Agenda

- Background on point-to-multipoint (P2MP) MPLS
  - Status of protocol standards
- IPTV multicast transport requirements
- High availability
  - Data plane protection and restoration
  - Control plane restart
- Control plane performance
- Considerations for implementation and deployment of P2MP MPLS

What is P2MP MPLS?

- Point-to-point (P2P) MPLS widely deployed
  - Quality of service (QoS)
  - Fast protection and restoration
  - Traffic engineering (TE)
  - Manageability, e.g. OAM
- Point-to-multipoint (P2MP) MPLS
  - Same benefits as P2P
  - Data flow optimized for P2MP
  - RSVP-TE and LDP variants
    - Concentrating on RSVP-TE here

P2MP MPLS Network



- Bandwidth shared where possible
- Any multicast tree optimization scheme allowed

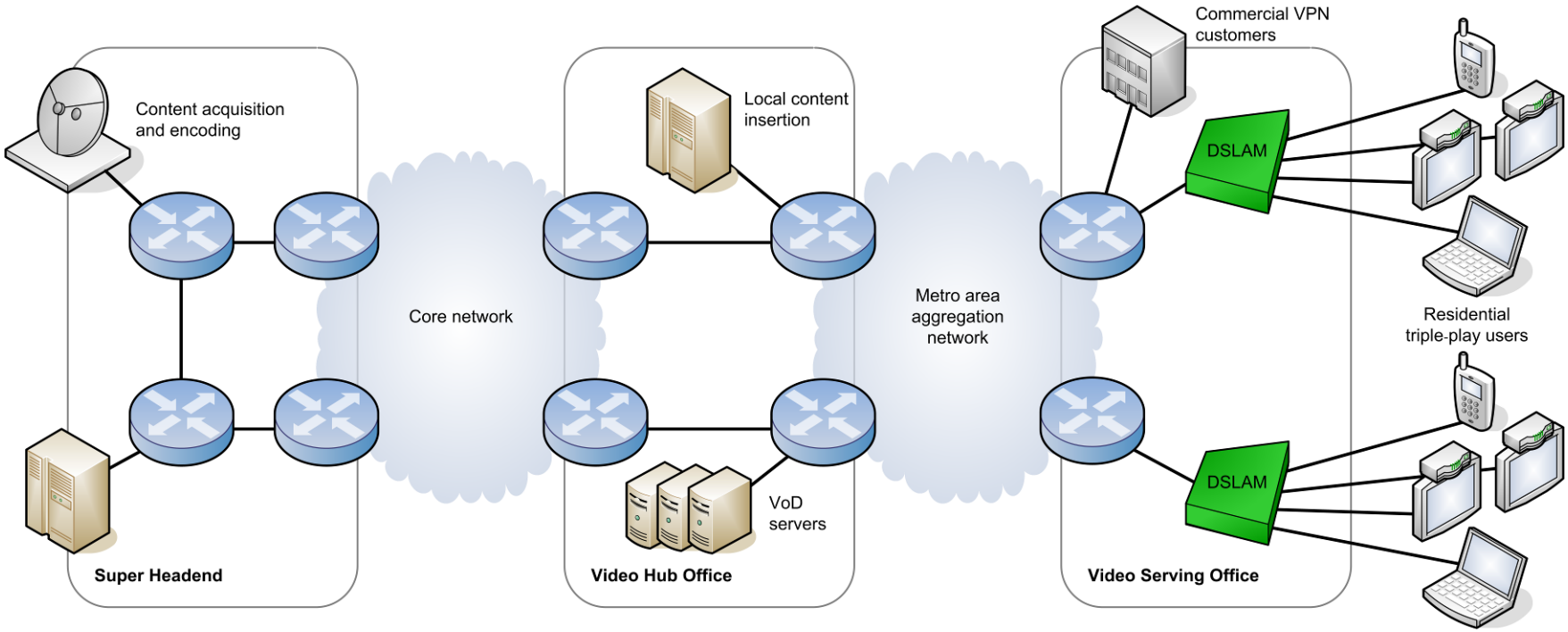
Status of P2MP MPLS Protocols

- RFC 4875 defines P2MP RSVP-TE
  - Works for traditional MPLS and GMPLS which includes
    - TDM
    - MPLS-TP (work in progress)
    - WDM (in principle)
- Because it uses RSVP-TE it naturally provides
  - QoS, where each node “signs the traffic contract”
  - TE for diverse routes and traffic optimization
  - Protection and restoration
    - Some, but not all variants
- TE routing protocols largely unchanged

What is it for?

- Key application is IPTV
  - Traditional TV better than 5 9's reliable
  - So for IPTV to compete it needs
    - QoS
    - High availability
      - Data plane protection and restoration
      - Diverse paths prepared in advance to bypass failures
      - Control plane recovery
- Other applications include
  - Multicast VPNs
    - L2VPN and L3VPN IETF WGs

Triple-play Network with IPTV



High Availability

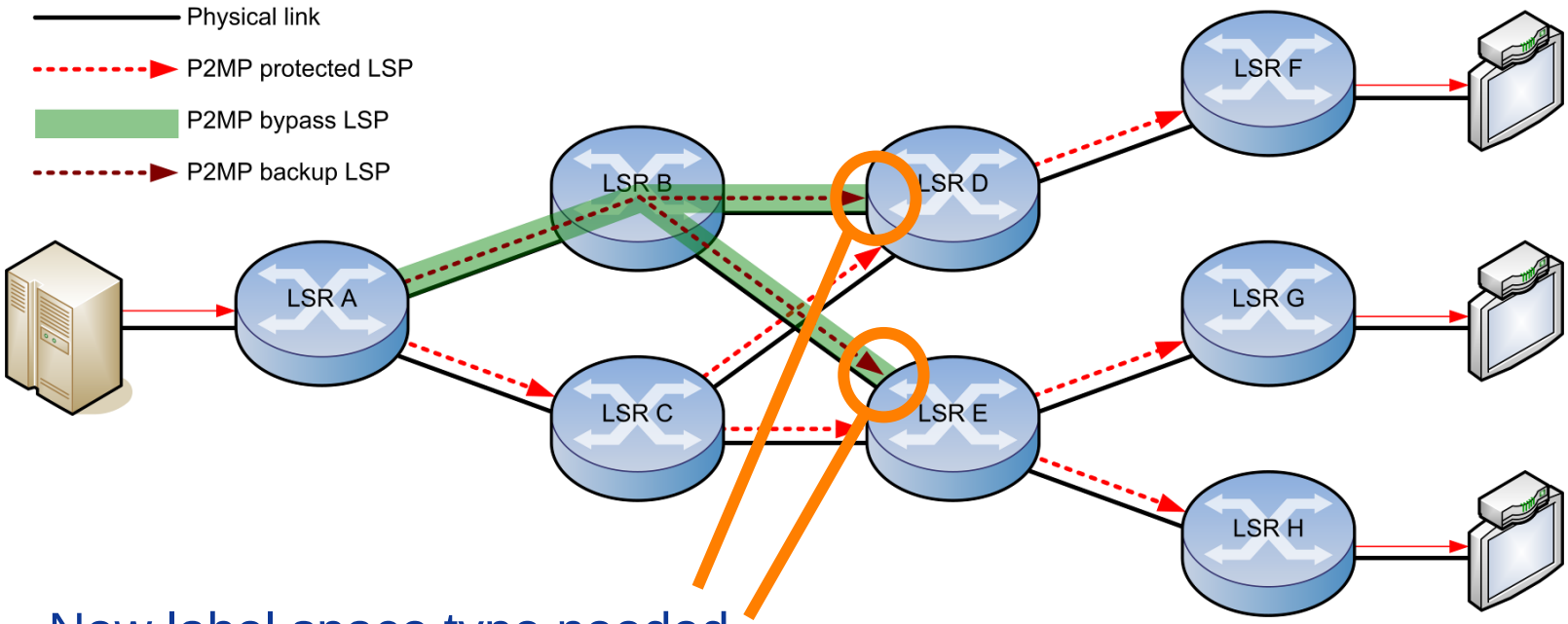
- Data plane protection and restoration
  - Packet MPLS Fast Reroute (FRR)
    - Facility (bypass) FRR
    - One-to-one (detour) FRR
  - GMPLS schemes (for MPLS-TP, TDM etc.)
    - End-to-end (e2e) recovery
    - Segment recovery
- Control plane recovery
  - Graceful restart
  - Failover to a hot backup

Protection Using FRR

- RFC 4090 describes 2 FRR schemes
  - Detour FRR not clearly defined for P2MP
  - Bypass FRR works, but complex
    - Tunnels data through a bypass LSP following a failure
    - Relatively simple for the case of P2P bypass tunnels
    - Extension to P2MP bypass tunnels is complex

- Is 50ms switch-over quick enough?
  - Risk of I-frame loss

Facility (bypass) FRR



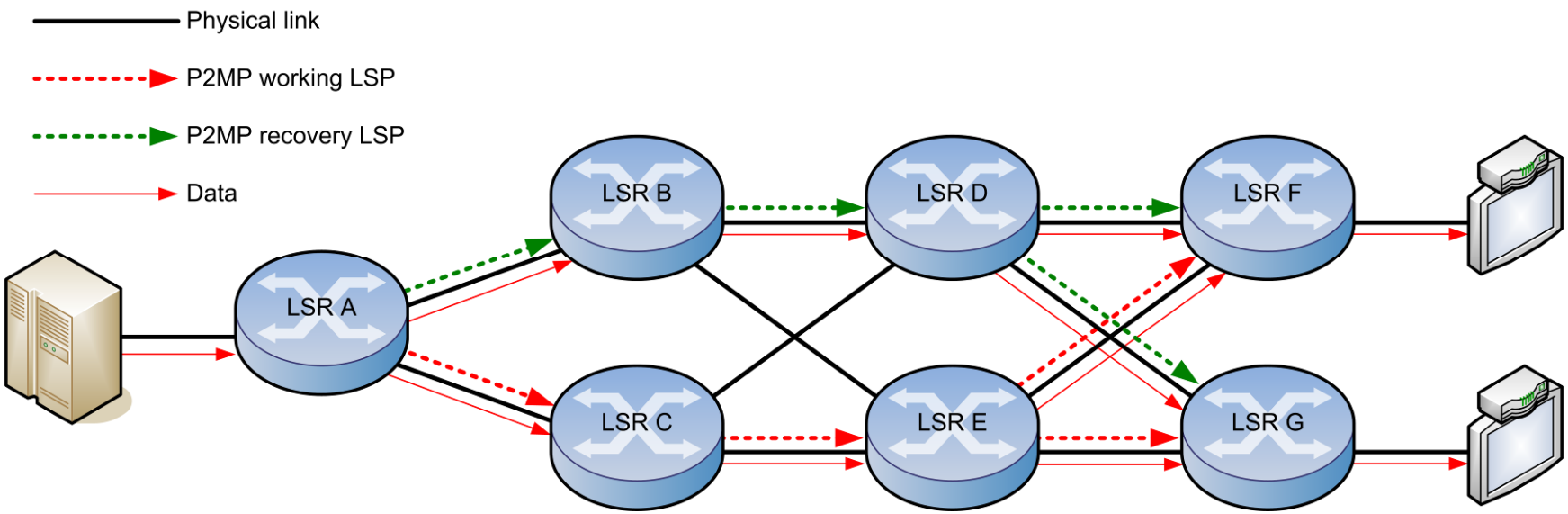
New label space type needed

- Upstream-assigned, context-specific labels
- Requires new hardware

End-to-end recovery

- RFC 4872
  - GMPLS, MPLS, MPLS-TP
  - Several different recovery schemes
- 1+1 unidirectional protection
  - Deliver data on primary and backup simultaneously
  - Leaf nodes always receive all packets
    - In principle can guarantee no I-frame loss
  - Maybe best choice for IPTV?
- Others slow to recover or standards incomplete

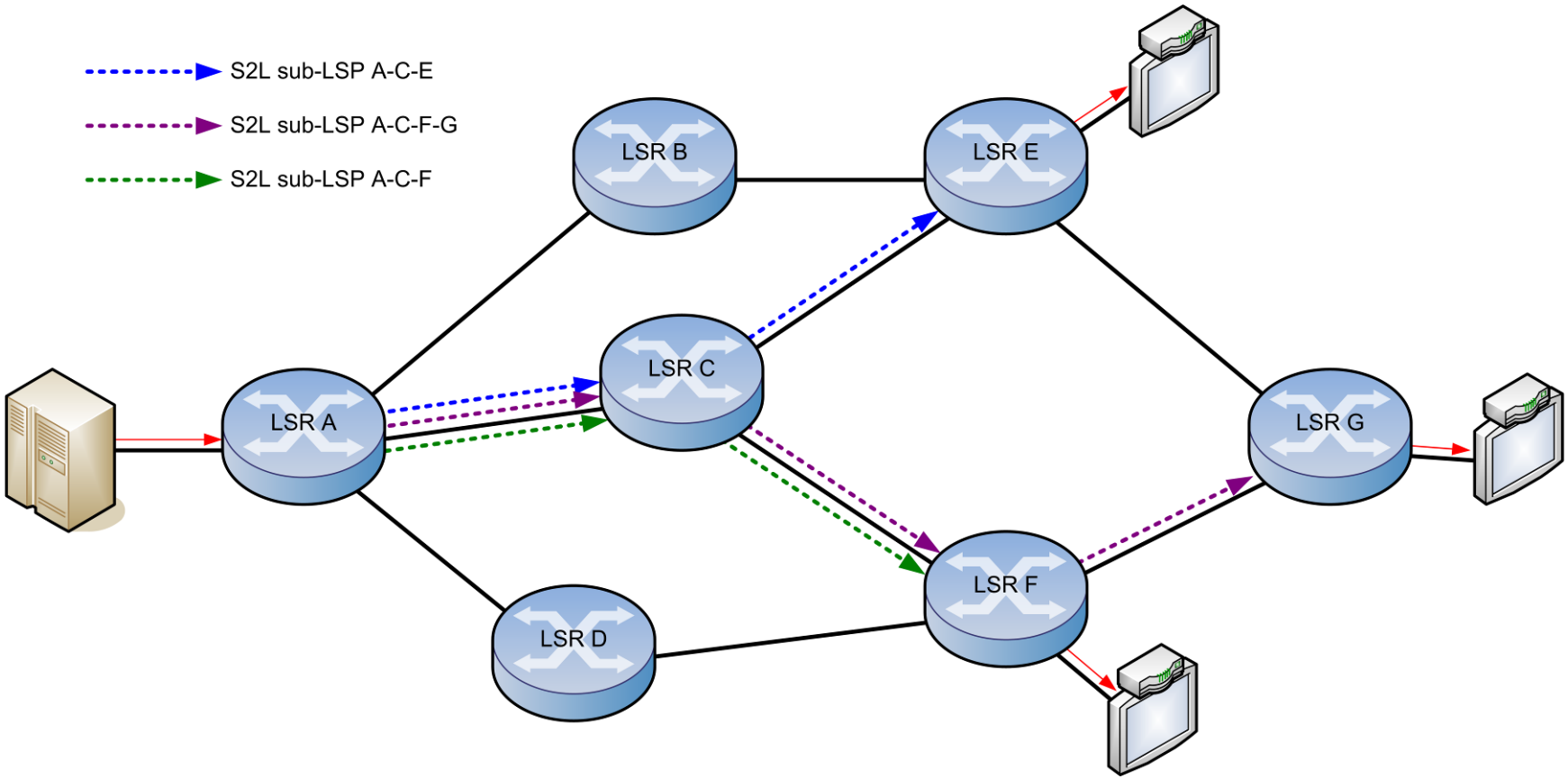
Potential P2MP e2e signalling



Control Plane Recovery

- What if the control plane fails?
  - Hot-backup can take over
    - State pre-loaded into backup
    - In-service software upgrade also possible
    - Tried and tested for P2P case
    - No issues for the P2MP case
  - Control plane restart
    - State re-learned from neighbours
    - Original RFC 3471 insufficient for the P2MP case
      - Revised RFC 5063 solves the problem
- For both mechanisms, data flow is unaffected

Source-to-leaf (S2L) sub-LSPs



Control Plane Performance

- Network scale (assuming IPTV)
  - Relatively few Source Nodes (NSource)
    - Say 10 …
  - How many Leaf Nodes (NLeaf)?
    - Say 100, 1000 …
  - Number of S2L sub-LSPs in whole network
    - NSource * NLeaf, say 10k
  - Number of S2L sub-LSPs at one Source Node
    - 1k
  - These are small numbers compared to P2P
    - Even if each S2L sub-LSP signalled separately
- At this scale, no problem

Summary

- Traditional TV highly reliable, so IPTV needs
  - 1+1 protection (or better)
  - Control plane recovery
- P2MP MPLS is ready to be deployed
  - Complicated, but can be done
  - Questions to ask your supplier?
  - Questions for me?
- Thank you
  - Nic.Neate@dataconnection.com
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