



## **The Challenges of MPLS for IPTV Video Transport**

Presented to Telecom@NAB 2007  
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## MPLS – Multi Protocol Label Switching

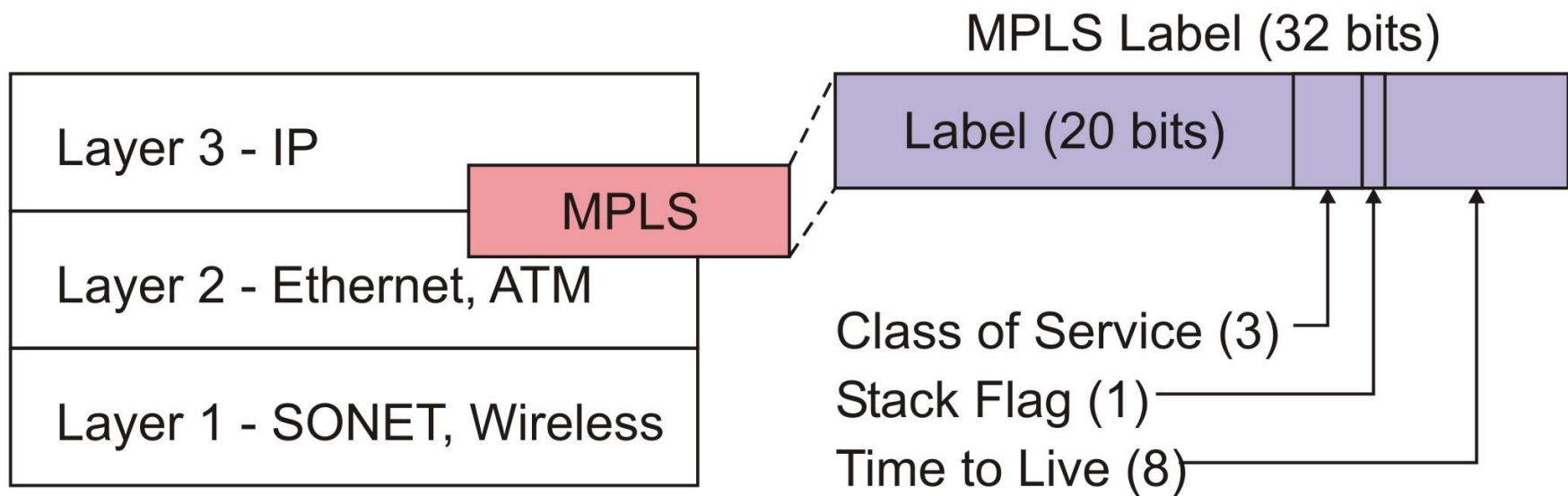
- Connections on Connectionless Network
  - ✓ Replace IP addresses with Labels in Core
  - ✓ Short Labels are easier to process
  - ✓ Label Switched Paths (LSPs) define end-to-end routes
  - ✓ Labels can be changed at each hop
  - ✓ Multiple Labels can be applied to each packet
  
- Label Switching, not Packet Routing
  - ✓ Label stack applied to each packet
  - ✓ Labels Indicate Forwarding Equivalence Class of packets
  - ✓ Packets in same Class get transported together

*Route at the Edge, Switch in the Core*



## Labels Applied Between Layer 2 and Layer 3

- Layer 3 – Network Layer – Internet Protocol
- Layer 2 – Link Layer – Multiple Choices, including Ethernet, ATM
- Layer 1 – Physical Network – Fiber, Copper,



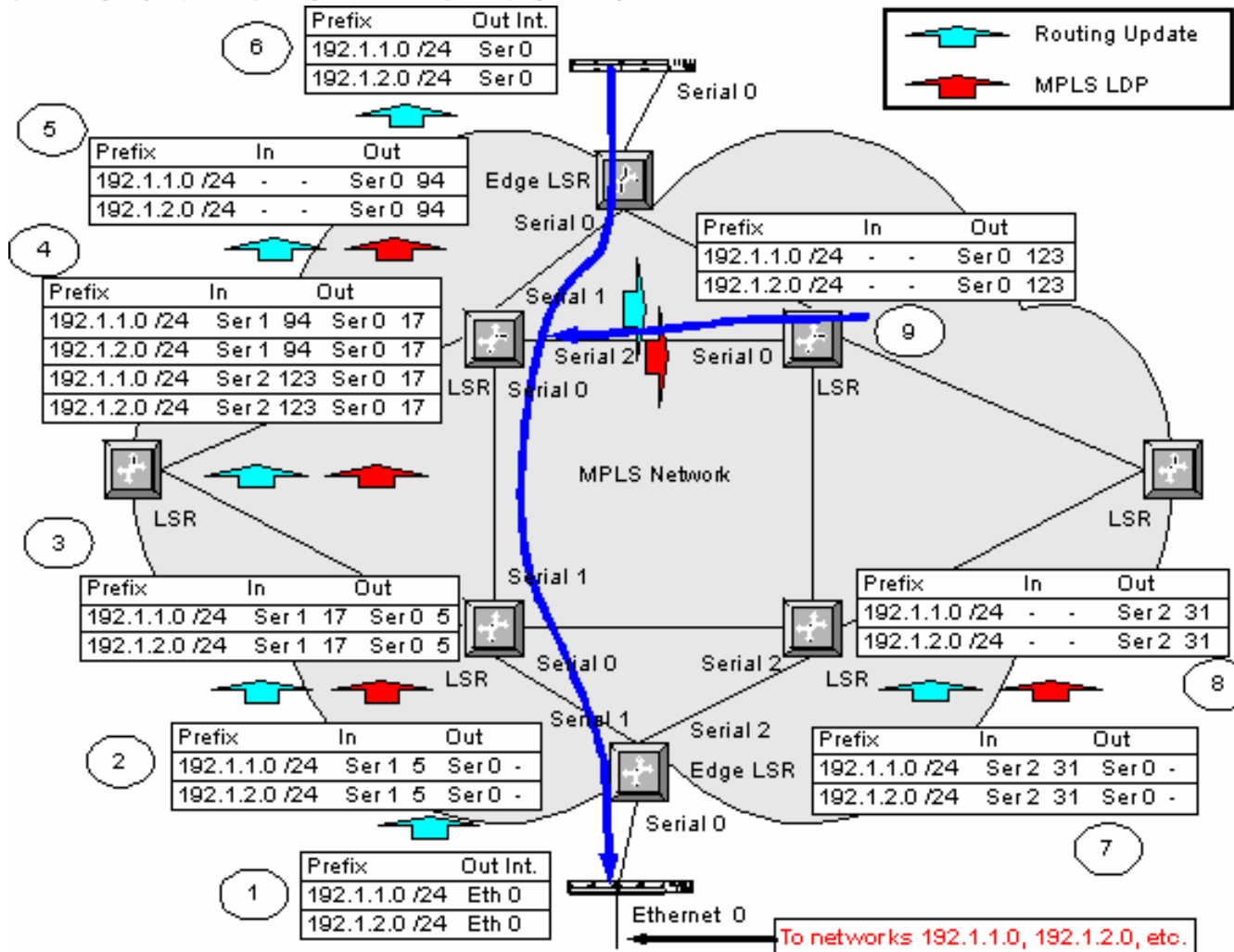


## Equipment Classes

- Label Edge Routers (LERs)
  - ✓ LERs sit at edges of MPLS networks
  - ✓ Provide interfaces to non-MPLS devices
  - ✓ Accept data streams from a variety of sources
  - ✓ Apply Labels to incoming packets
  - ✓ Manage route discovery process
  
- Label Switch Routers (LSRs)
  - ✓ LSRs sit in core of MPLS networks
  - ✓ Process labeled traffic quickly and efficiently
  - ✓ Do not perform routing – simply process label stacks
  - ✓ Packets with same label stack will follow same route



# MPLS Label Stack Creation



Source: Introduction to MPLS by Peter Welcher, Chesapeake Netcraftsmen <http://www.netcraftsmen.net/>

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## MPLS Benefits and Issues

- Benefits of MPLS
  - ✓ Replace IP addresses with Labels (4 bytes vs. 20 bytes)
  - ✓ Multiple Protocols to set up data paths
    - LDP – Label Distribution Protocol
    - RSVP – ReSerVation Protocol
    - BGP – Border Gateway Protocol
  - ✓ Supports Virtual Private Networks (VPNs)
  - ✓ Can give high Quality of Service (QoS) to Video, Voice
  
- MPLS Issues
  - ✓ All Core Switches in Network must be MPLS enabled
  - ✓ Public Internet is **NOT** MPLS enabled
  - ✓ Multicasting requires enhanced modes such as Point to Multipoint Label Switched Paths or VPLS
  - ✓ Bandwidth Management Issues

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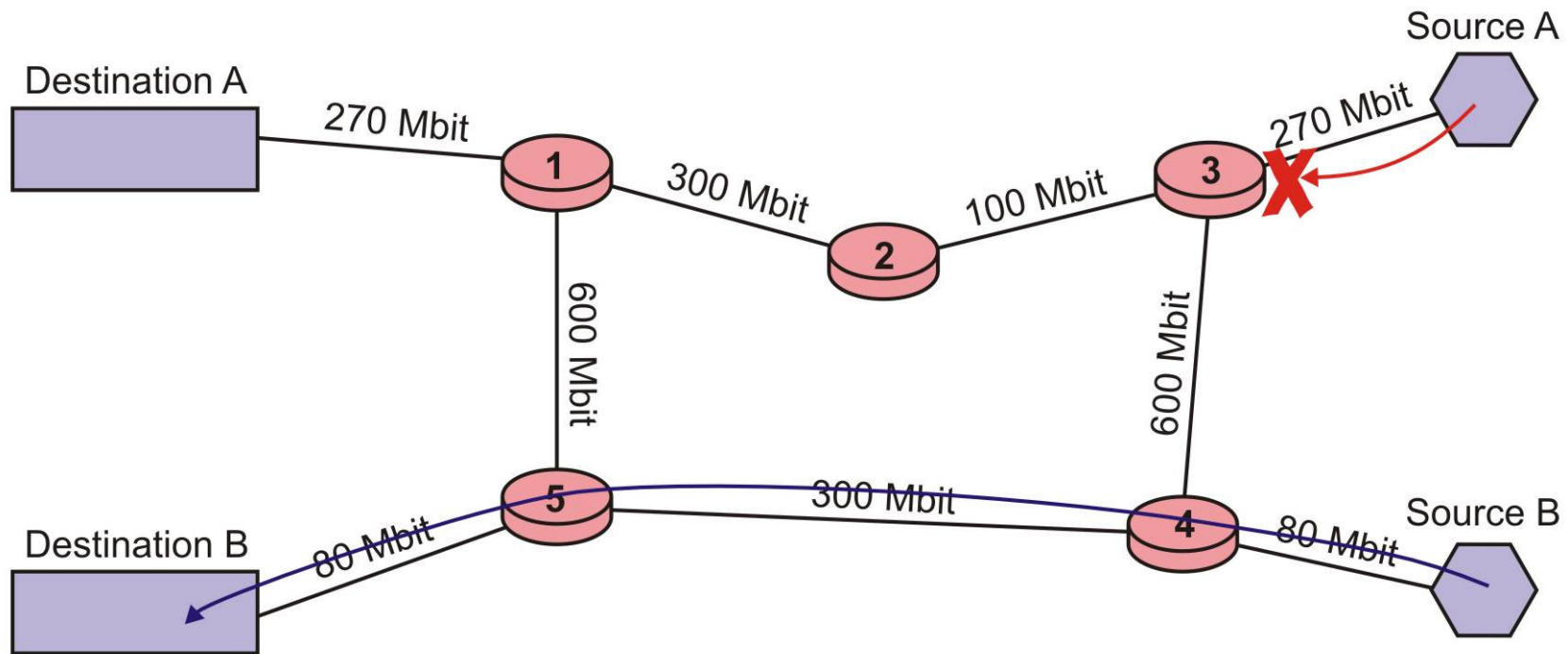
## *Network Core Issues*

- All Core Routers must be MPLS enabled
  - ✓ Only Labels are used to control packet flow inside core
  - ✓ Packets must flow through LER function and acquire labels to enter core
  
- Internet Not MPLS Enabled
  - ✓ Currently, the Public Internet is not set up for MPLS
  - ✓ Many Carriers offer MPLS Private Line and VPN services to individual clients
  - ✓ Connectivity to other clients requires agreements, planning and defined interface points



## Bandwidth Management

- Difficult to Reserve Resources for Future Use
  - ✓ 80 Mbit Feed From B to B from 4:00 – 6:00





## Handling Heavy Cargo – Large Video Streams



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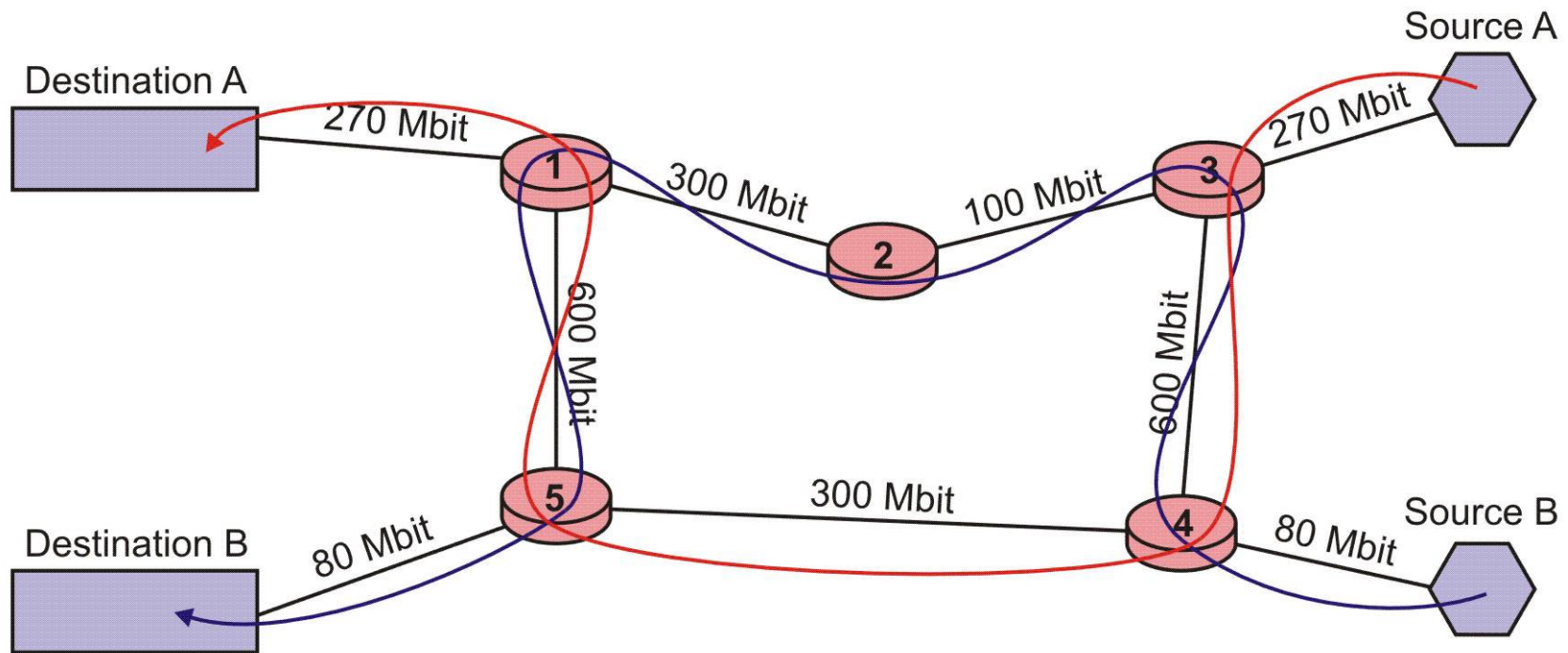
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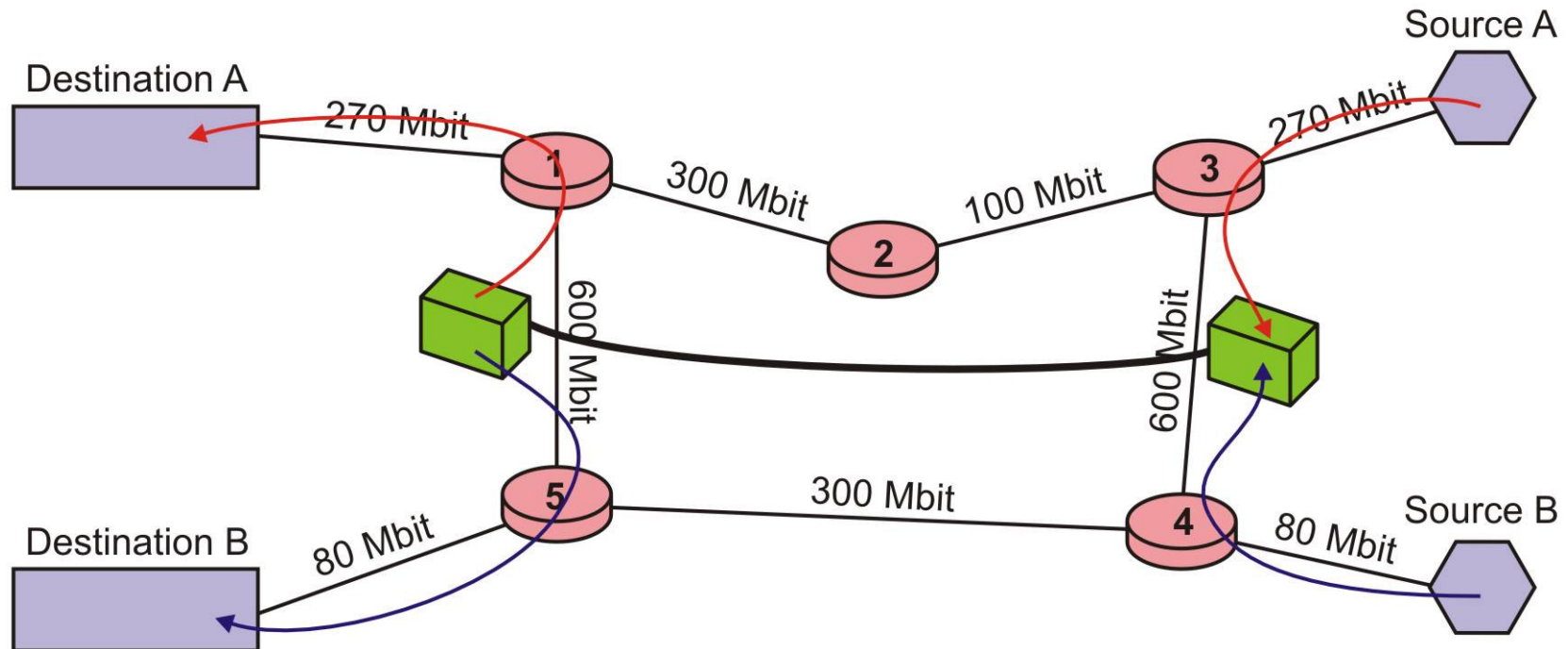
## *Economic Considerations*

- Network Core Resources are Expensive
  - ✓ Manage thousands of flows
  - ✓ Low and High Speed Traffic
  - ✓ Many different protocols and packet types
  - ✓ Complex Operating Systems and management tools
  
- Video Networking
  - ✓ Relatively Few Flows
  - ✓ High Bandwidth per Flow
  - ✓ High Priority Flows – Need Uninterrupted, Low Jitter Packet Flow
  - ✓ Less expensive than General Purpose MPLS Core Router



## Another Approach

- Use High Speed Backbone to Deliver Video close to Edge
  - ✓ Augment capacity of IP Backbone





## IP Video Router

- Key Attributes
  - ✓ Able to handle High-Bandwidth flows – uncompressed HD, SD
    - Supports Multicasting
  - ✓ Non-blocking Architecture
    - Avoid re-routing established connections
    - Set-up new connections on any available bandwidth – No waste
  - ✓ Low cost per stream
    - Specifically tuned to handle small number of high-bandwidth flows
    - Reduced complexity with small IP forwarding table
    - Hardware-based forwarding engine
  - ✓ Guaranteed bandwidth
    - Global connections, through use of network resource manager
    - Advance reservations possible for future events
    - Mathematically optimal non-blocking routing algorithms
  - ✓ Hitless Protection Switching
    - Implemented at edge of the network
    - Protects against core and access fiber or equipment failure

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## Handling Heavy Cargo



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## Conclusion

- MPLS is a valuable tool for many types of data communications. However, for contribution-quality video, multiple issues arise.
- These issues include complexity in reserving bandwidth for future events and high equipment costs.
- Alternative technology based on terabit-class routers optimized for the high-bandwidth flows commonly found in contribution quality video has started to emerge.
- These new devices provide predictable routing with pre-reserved bandwidth, IP multicasting, Hitless Protection Switching and lower equipment costs.