MULTIPROTOCOL LABEL SWITCHING (MPLS) - I

Multiprotocol label switching (MPLS) improves the overall performance and delay characteristics of the Internet. MPLS transmission is a special case of tunneling and is an efficient routing mechanism. Its connection-oriented forwarding mechanism, together with layer 2 label-based lookups, enables traffic engineering to implement peer-to-peer VPNs effectively.

MPLS adds some traditional layer 2 capabilities and services, such as traffic engineering, to the IP layer. The separation of the MPLS control and forwarding components has led to multilayer, multiprotocol interoperability between layer 2 and layer 3 protocols. MPLS uses a small label or stack of labels appended to packets and typically makes efficient routing decisions. Another benefit is flexibility in merging IP-based networks with fast-switching capabilities. This technology adds new capabilities to IP-based networks:

- Connection-oriented QoS support
- Traffic engineering
- VPN support
- Multiprotocol support

Traditional IP routing has several limitations, ranging from scalability issues to poor support for traffic engineering. The IP backbone also presents a poor integration with layer 2 existing in large service provider networks. For example, a VPN must use a service provider's IP network and build a private network and run its own traffic shielded from prying eyes. In this case, VPN membership may not be well engineered in ordinary IP networks and can therefore result in an inefficient establishment of tunnels.

MPLS network architectures also support other applications, such as IP multicast routing and QoS extensions. The power of MPLS lies in the number of applications made possible with simple label switching, ranging from traffic engineering to peer-to-peer VPNs. One of the major advantages of MPLS is integration of the routing and switching layers. The development of the label-switched protocol running over all the existing layer 2 and layer 3 architectures is a major networking development.

MPLS Operation

MPLS is based on the assignment of labels to packets. Assigning labels to each packet makes a label-swapping scheme perform its routing process much more efficiently. An MPLS network consists of nodes called label switch routers (LSR). An LSR switches labeled packets according to particular switching tables. An LSR has two distinct functional components: a control component and a forwarding component. The control component uses routing protocols, such as OSPF and the border gateway protocol (BGP). The control component also facilitates the exchange of information with other LSRs to build and maintain the forwarding table.

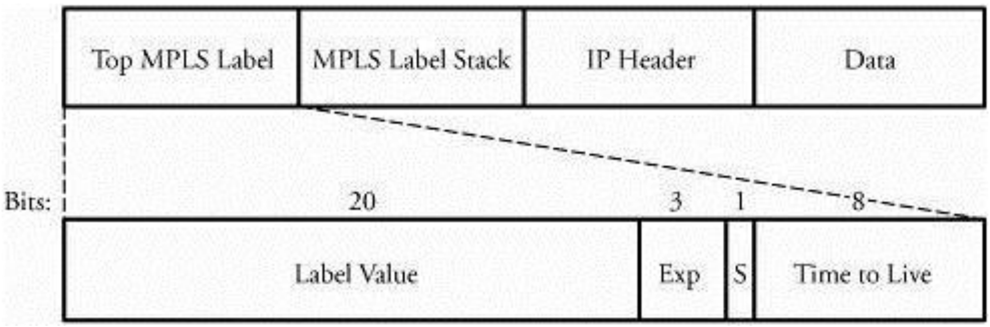
A label is a header used by an LSR to forward packets. The header format depends on the network characteristics. LSRs read only labels and do not engage in the network-layer packet headers. One key to the scalability of MPLS is that labels have only local significance between two devices that communicate. When a packet arrives, the forwarding component uses the label of the packet as an index to search the forwarding table for a match. The forwarding component then directs the packet from the input interface to the output interface through the switching fabric.

MPSL Packet Format

MPLS uses label stacking to become capable of multilevel hierarchical routing. A label enables the network to perform faster by using smaller forwarding tables, a property that ensures a convenient scalability of the network. Figure 6.6 shows the MPLS header encapsulation for an IP packet. An MPLS label is a 32-bit field consisting of several fields as follows.

- Label value is a 20-bit field label and is significant only locally.
- Exp is a 3-bit field reserved for future experimental use.
- S is set to 1 for the oldest entry in the stack and to 0 for all other entries.
- Time to live is an 8-bit field used to encode a hop-count value to prevent packets from looping forever in the network.

Figure 6.6. MPLS header encapsulation for an IP packet



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