INF5050 - Protocols and routing in internet

Multiprotocol Label Switching (MPLS) / Generalized Multiprotocol Label Switching (GMPLS)

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Outline

Background

- What is MPLS?
  - Mechanism that directs data from one network node to the next based on on path labels rather than network addresses.
  - with such mechanism, we avoid lookups in a routing table
  - MPLS switches packets (IP packets) instead of routing packets to transport the data
- Why MPLS?
  - Provide a highly scalable mechanism that was topology driven rather than flow driven
  - Load balance traffic to utilize network bandwidth efficiently
  - Allow core routers/networking devices to switch packets based on a simplified header
  - Remove the complexity and overhead of network managements (Assemble and reassemble IP packets)

MPLS was conceived, why?

- The shortest path routing protocols like IS-IS and OSPF
  - Did not take capacity characteristics into account while making the routing decisions
  - The outcome is, segmentation over the network which leads to congestion, while others remain under-utilized.
- MPLS reduces the complexity and redundancies by adding new network functionalities.

MPLS Fundamentals

- Main idea:
  - attach a short fixed-length label to packets at the ingress to an MPLS domain
  - the labels are used to make the forwarding decisions.
- MPLS consists of a forwarding and a control plane. Though they are decoupled and independent from each other.
- Supports explicit routed path.
- Provides Quality of Service (QoS) if it is implemented with Diff-Serv and Constraint-based routing.

Diff-Serv and Constraint-based routing

- Differentiated Services
  - A network architecture for classifying and managing network traffic and provide QoS on modern IP networks.
  - it is used to provide low-latency to critical network traffic. (Media, VOIP).
- Constraint-based routing
  - It is a routing technique where resource availability and traffic characterization are taken into account.
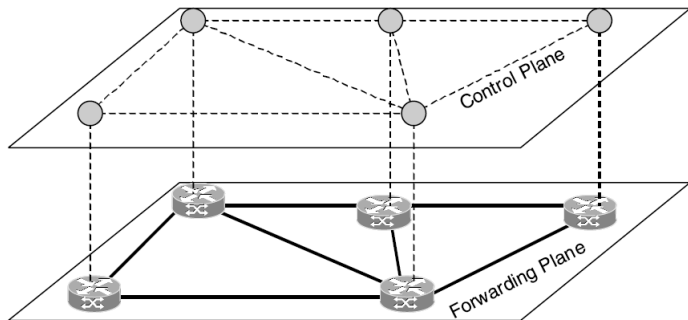
MPLS Fundamentals

Fig. 2. Conceptual view of MPLS control plane and forwarding plane.

MPLS Fundamentals: Control Plane

MPLS Fundamentals: Forwarding Plane

MPLS: Terminology

- FEC (Forwarding Equivalence Class)
  - Group of IP packets which are forwarded in the same manner (e.g. over the same path, with the same priority and the same label)
- Label
  - Short fixed length identifier which is used to identify a FEC
- Label Swapping
  - Looking up the oncoming label to determine the outgoing label, encapsulation and port
- Label switched path (LSP)
  - Path through one or more LSR for a particular FEC
- Label switching router (LSR)
  - an MPLS capable router

FEC

Advantages?

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Disadvantages of MPLS

GMPLS

- ▶ What is GMPLS?
  - ▶ a protocol suite extending MPLS to manage further classes of interfaces and switching technologies other than packet interfaces and switching, such as time division multiplex, layer-2 switch, wavelength switch and fiber-switch.

GMPLS

- GMPLS is an extended form of MPLS and some of these improvements are:
  - RSVP-TE
  - OSPF and IS-IS
  - New link-management protocol
  - Bi-directional LSP setup
    - Reduce latency
    - Less control overhead
    - Route selection is simpler
    - Cleaner interface
  - MPLS emphasizes the seperation of control plane and network plane
  - GMPLS extends this seperation and allows the control plane to be physically diverse from the associated data plane

GMPLS: Hierarchial LSP

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Summary

- MPLS
- GMPLS

Resources

- Generalized Multiprotocol Label Switching: An Overview of Signaling Enhancements and Recovery Techniques IEEE Communication Magazine, July 2001. A. Banerjee et. al.
- Internet Traffic Engineering Using Multi-Protocol Label Switching (MPLS). Computer Networks 40, Elsevier, 2002 D.O. Awduche and B. Jabbari.