

## Multicast & MPLS

### Outline

- Multicast for LS
- Multicast for DV
- Protocol Independent Multicast
- MPLS

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## Process Groups

- Any set of processes that want to cooperate
- Processes can join/leave a group
- A process can belong to many groups
- Groups can be either open or closed
- Use multicast rather than point-to-point messages
  - group name (address) provides a useful level of indirection
- Example uses
  - data dissemination (e.g., news)
  - replicated servers

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## Multicast Addresses

- Subrange of IP address space reserved for MC (class D for IPv4)
- IPv4: 28 bits of possible MC addresses
- Ethernet: uses 23 bits for multicast
- Mapping 28 bits onto 23 bits: 32 IP addresses map into each one of the Ethernet addresses
- Ethernet host joins IP MC group by configuring device to receive Ethernet MC address. IP at host must inspect packet if actually directed to this host

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## Multicast Routing: LS

- Each host on a LAN periodically announces the groups it belongs to using IGMP
- Augment update message (LSP) to include set of groups that have members on a particular LAN
- Each router uses Dijkstra's algorithm to compute shortest-path spanning tree for each source/group pair
- Each router caches tree for currently active source/group pairs

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## Multicast Routing: DV

- Reverse Path Broadcast
  - Each router already knows that shortest path to S goes through router N
  - When receive multicast packet from S, forward on all outgoing links (except one it arrived on), iff packet arrived from N
  - Eliminate duplicate broadcast packets by letting only "parent" for LAN (relative to S) forward
    - shortest path to S (learn from distance vector)
    - smallest address to break ties

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## DV (cont)

- Reverse Path Multicast
  - Goal: prune networks that have no hosts in group G
  - Step 1: determine if LAN is a *leaf* w/o members in G
    - leaf if parent is only router on the LAN
    - determine if any hosts are members of G using IGMP
  - Step 2: propagate "no members of G here" information
    - augment (destination, cost) update sent to neighbors with set of groups for which this network is interested in receiving multicast packets
    - only happens when multicast address becomes active

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## Protocol Independent Multicast

- PIM: sparse mode (PIM-SM) and dense mode
- Routers join/leave groups: Join/Prune messages
- Rendezvous Point (RP) for each group
- Shared trees and source-specific trees

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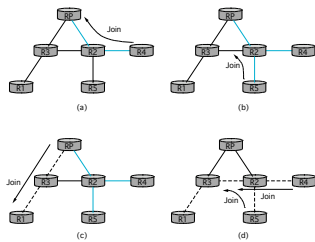
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## PIM



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## Multiprotocol Label Switching

- MPLS:
  - enable IP capabilities on devices that do not have capability to forward IP datagrams in normal manner.
  - forward IP packets along ‘explicit routes’.
  - support certain types of virtual private network services.

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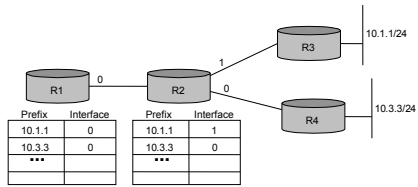
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## Destination-Based Forwarding



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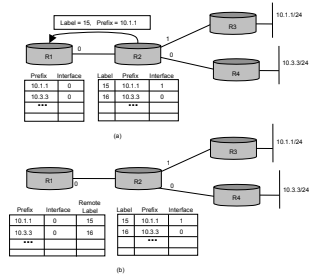
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## Label Distribution Protocol



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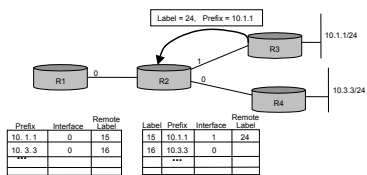
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## Label Distribution Protocol



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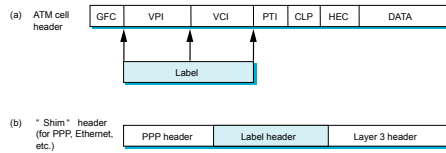
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## Label Switching Routers



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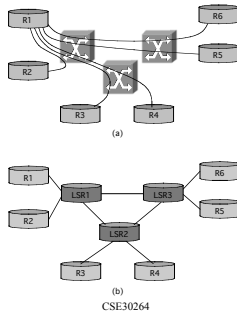
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## Benefits



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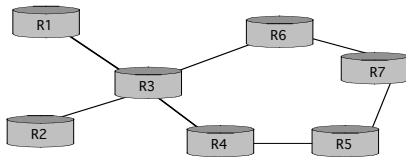
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## Explicit Routing

- “Fish” network
- Resource Reservation Protocol (RSVP)



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