

Tag/Label Switching

CS598: Advanced Internet

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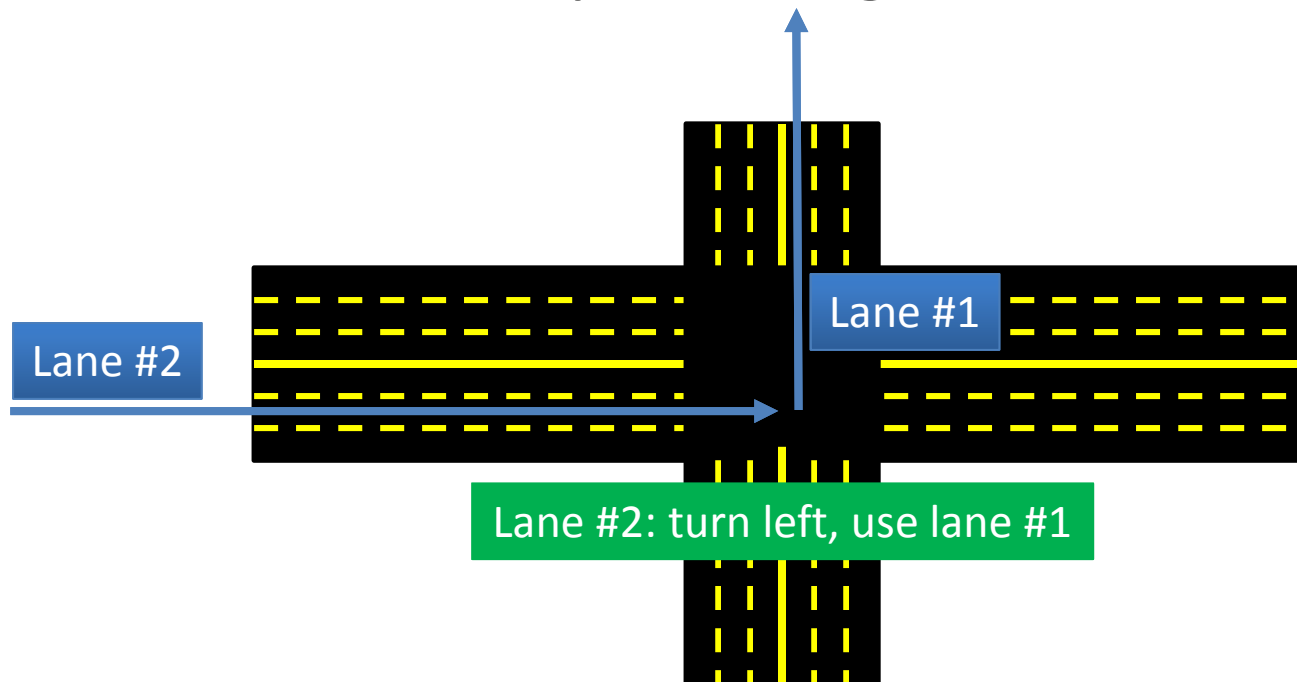
How to go from A to B?

- Broadcast:
 - Go everywhere, stop at B
 - Never ask for directions
- Hop by hop routing:
 - Ask who is closer to B, go there, repeat!
 - You better go to X first ...
- Source routing:
 - Get a list before starting
 - Go straight 5 blocks, take a left, 4 more blocks, ...



How to go from A to B?

- Let someone go ahead of you
- At every road reserve a lane for you
- At intersection, post a sign (turn + lane)



What is it good for?

- Enable IP capabilities on devices that cannot forward IP datagrams
- Explicit routing – pre-calculated routes that do not match normal IP routing paths
- Virtual Private Network (VPN) services

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One of the original goals is not on the list!

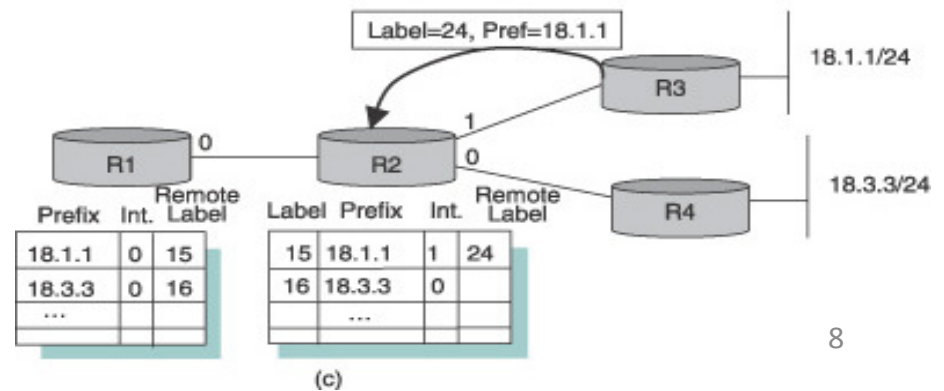
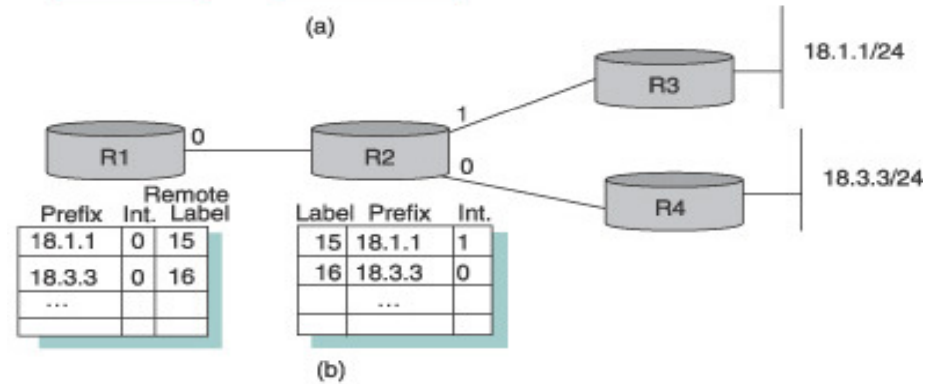
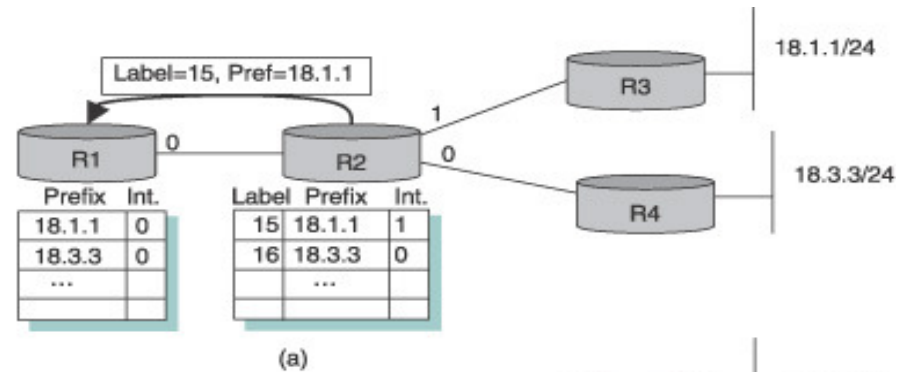
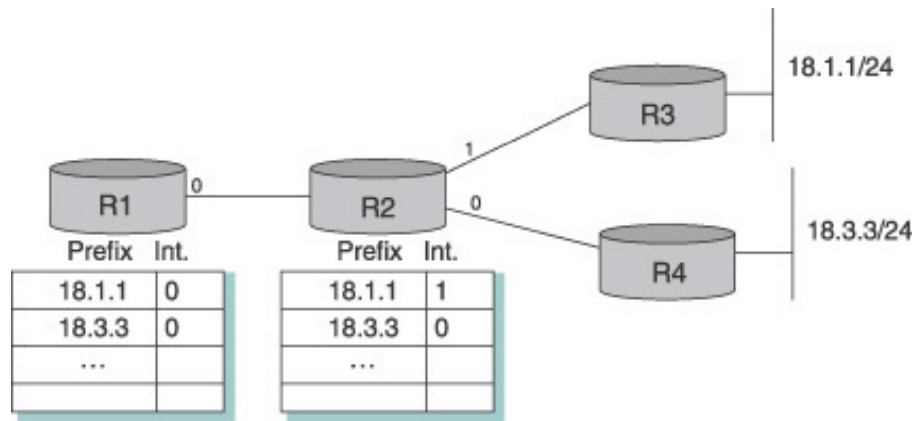
This Talk

- History
- Learn from Examples
 - Destination-based Forwarding
 - Explicit Routing
 - Virtual Private Networks and Tunnels
- Points to Ponder
 - What layer is MPLS?
- Where is MPLS now?

History

- Ipsilon Networks
 - IP switching, defined to work on ATM
- Cisco Systems, Inc.
 - Tag switching, proprietary proposal
 - Renamed label switching
 - Handed over to IETF
- IETF
 - Proposals from other vendors (Toshiba, IBM)

Destination-Based Forwarding

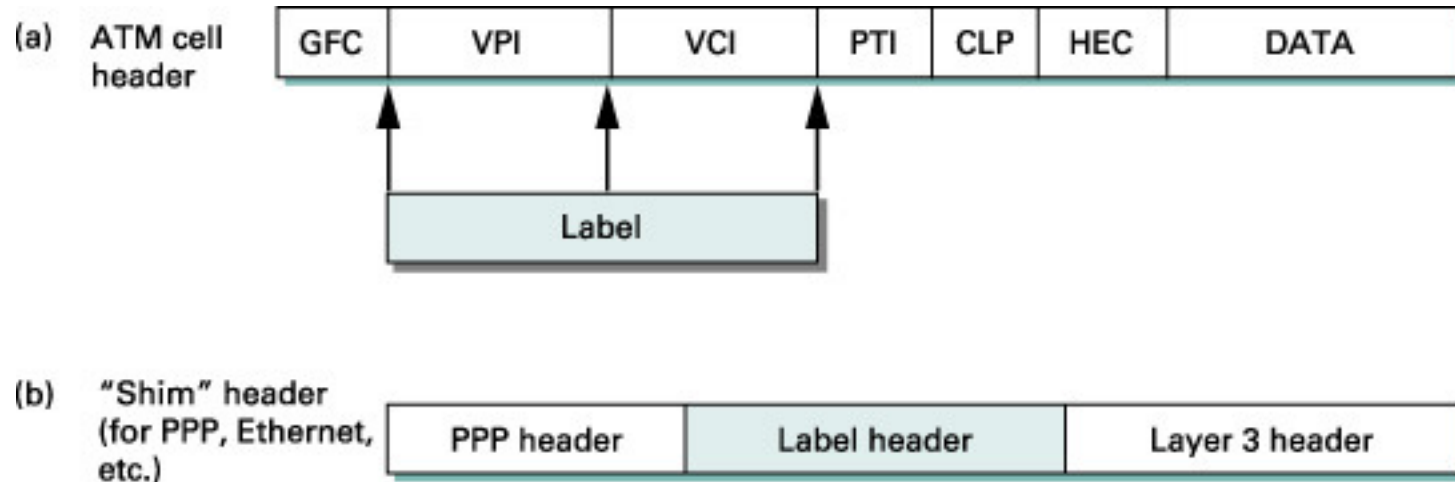


Benefits

- Exact match, as opposed to longest match
 - Simple to implement in hardware
- Forwarding Equivalence Class (FEC)
 - Set of packets that receive same forwarding treatment
- Devices not supporting IP can forward IP traffic
 - Example: carry IP traffic over ATM switches
 - How and Why?

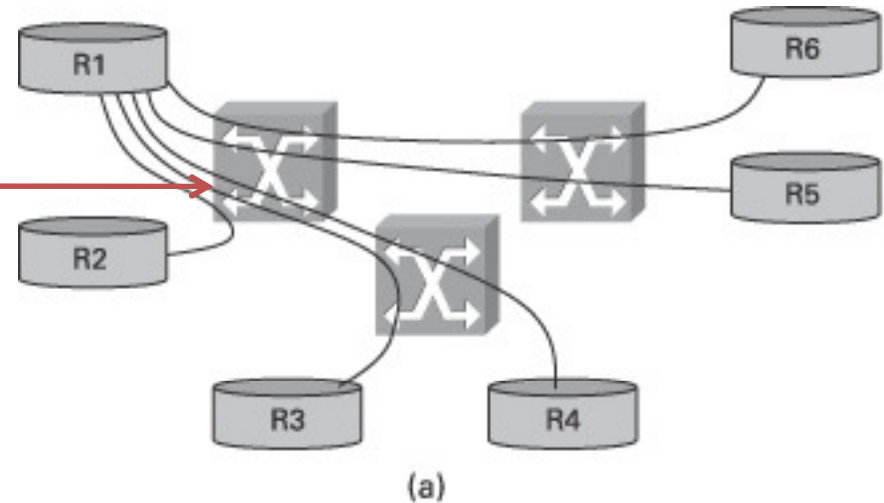
How?

- Provide switches with:
 - IP routing protocols
 - A method to distribute label bindings (LDP)
- Result: IP control protocols with label-swapping forwarding

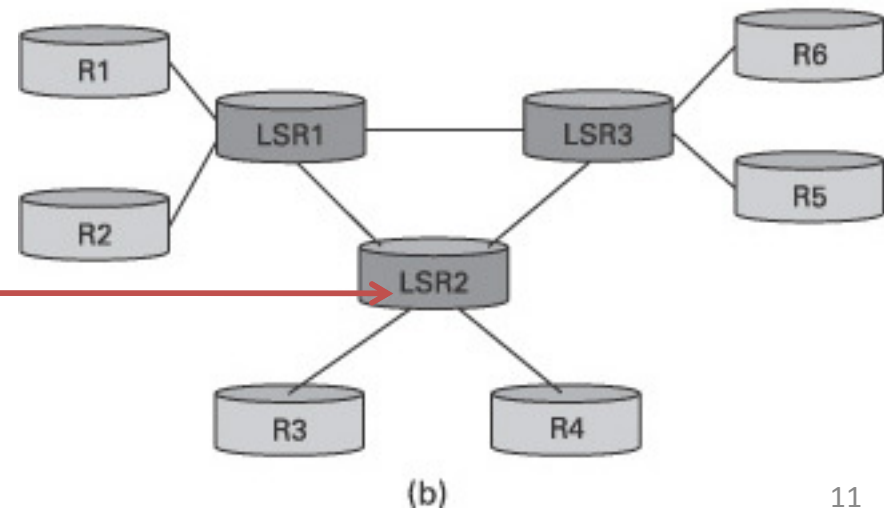


Why?

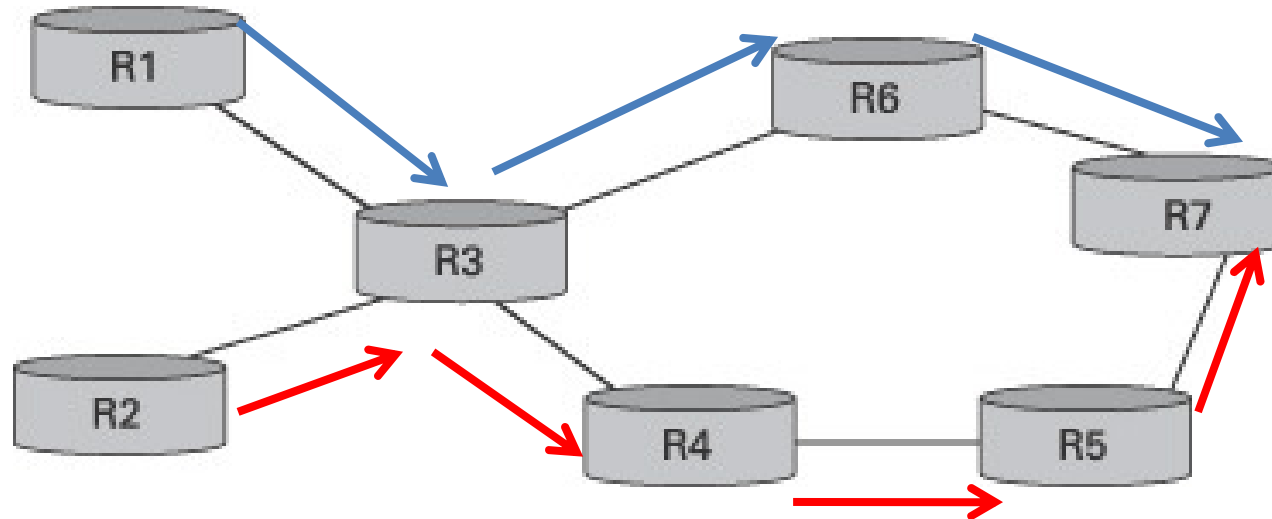
Set of routers connected over an ATM network (why?)



ATM switches are replaced with LSR (benefits?)



Explicit Routing



- Questions:
 - How to routers agree on what labels to use and how to forward packets with particular labels?

Applications of Explicit Routing

- Traffic Engineering
 - Controlling exactly which path the traffic flows
- Resilience in face of failure
 - Reroute traffic down a pre-calculated path
 - Known as Fast Reroute

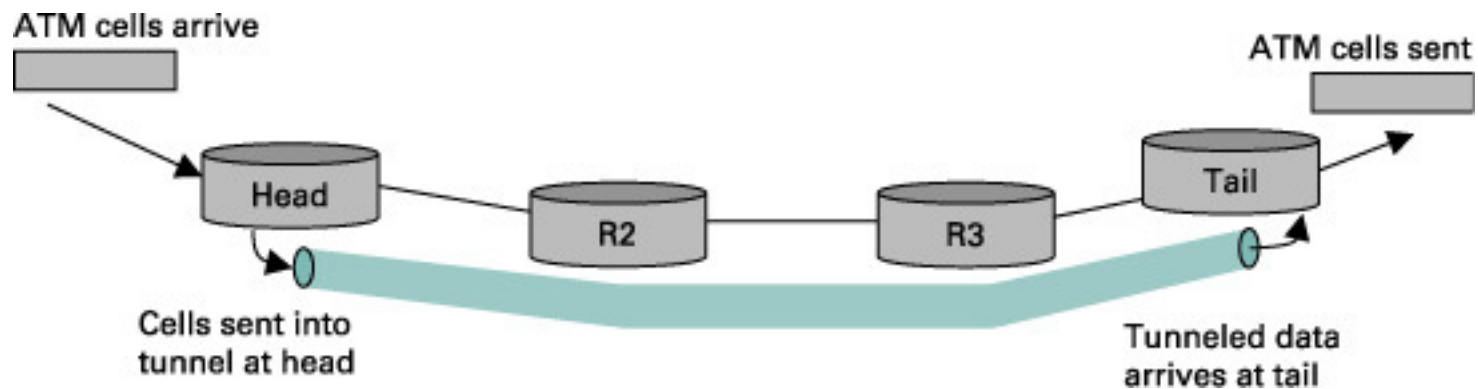
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How to calculate the explicit routes?

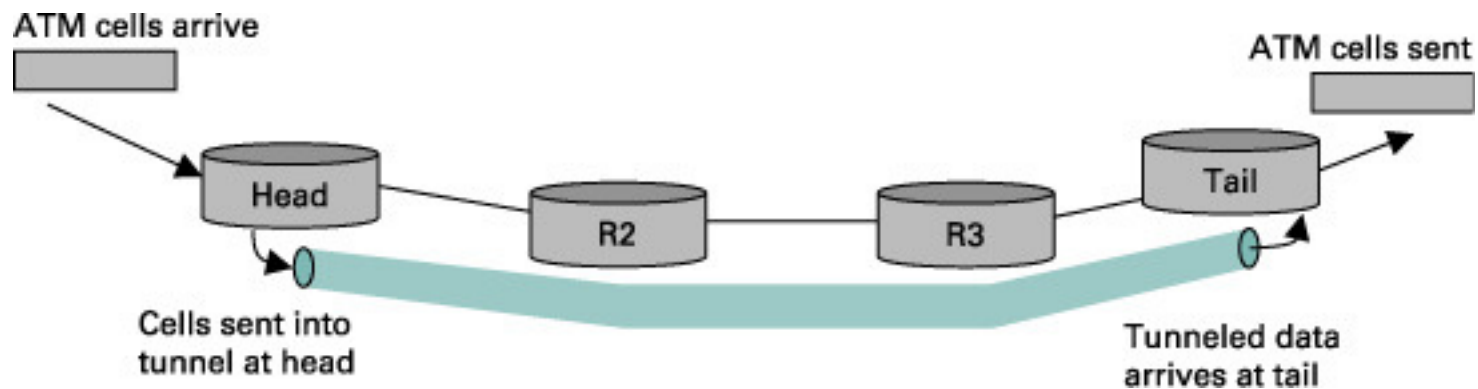
Virtual Private Networks

- “Layer 2” VPN
 - Tunnel layer 2 data (Ethernet frames/ATM cells)
 - Pseudo-wire emulation



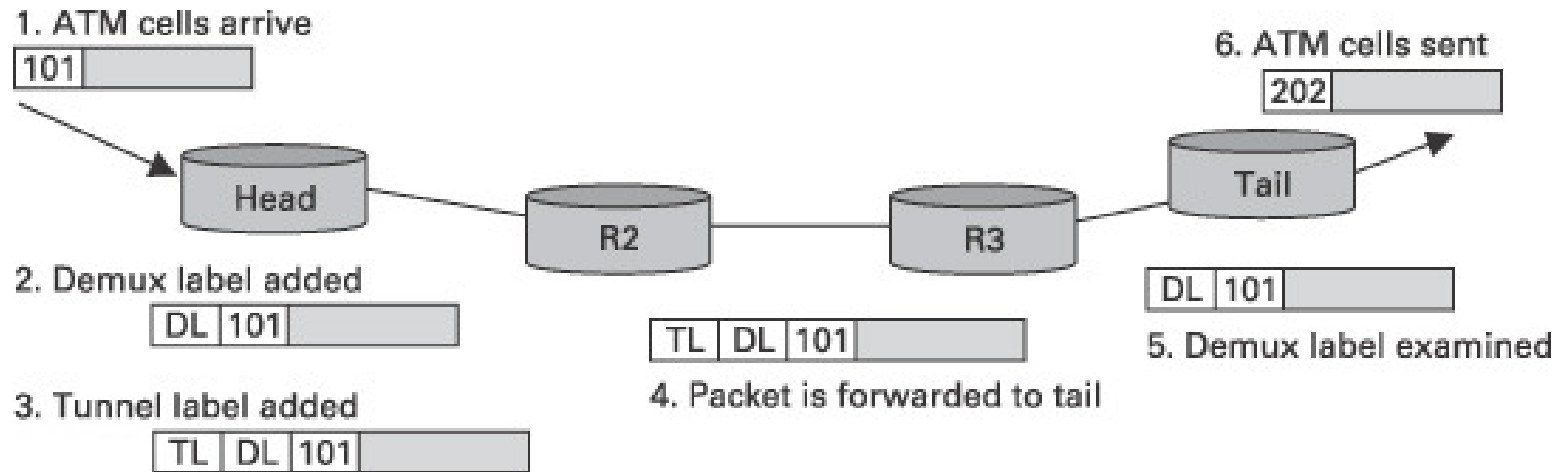
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What to do with non-IP traffic when it reaches the EOT?

VPN: ATM over IP



- Labels may be stacked on a packet to any depth
- A single tunnel can carry potentially large number of emulated circuits
- Same technique to provided hierarchy of routing knowledge

What Layer is MPLS?

- Layer 2.5
- Layer 2
- Layer 3

What Layer is MPLS?

- Layer 2.5
 - MPLS header is found between layer 3 and layer 2 headers
- Layer 2
 - IP packets are encapsulated inside MPLS headers
 - MPLS must be below IP
- Layer 3
 - MPLS uses IP routing protocols and IP addressing

Where is MPLS Now?

- Sufficiently popular among service providers
 - Almost all high-end routers include MPLS capabilities
- Two main applications:
 - Layer 3 VPN: Provide “private” IP services to corporations
 - Explicit Routing: TE and/or Fast Reroute
 - Difficult to determine how many providers are actually using this technology

Questions?