

Ignify Consulting

An Introduction to Multi-Protocol Label Switching

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Topics

- Traffic Engineering
- Why MPLS
- MPLS Architecture
- MPLS Components



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Traffic Engg.

Need for Traffic Engg.

- High cost of network assets
- Competitive nature of the internet

Goal of Internet Traffic Engg.

- To optimize network resource utilization
- To optimize traffic performance
- To provide resilient network, so that it can withstand link or node failures



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"Label Substitution" What is it?

One of the many ways of getting from A to B:

- **BROADCAST**: Go everywhere, stop when you get to B, never ask for directions.
- **HOP BY HOP ROUTING**: Continually ask who's closer to B go there, repeat ... stop when you get to B.

"Going to B? You'd better go to X, its on the way".

- **SOURCE ROUTING**: Ask for a list (that you carry with you) of places to go that eventually lead you to B.

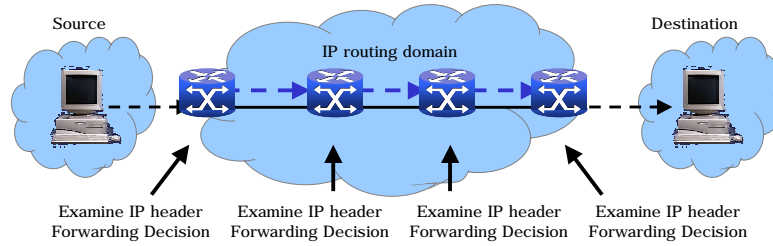
"Going to B? Go straight 5 blocks, take the next left, 6 more blocks and take a right at the lights".



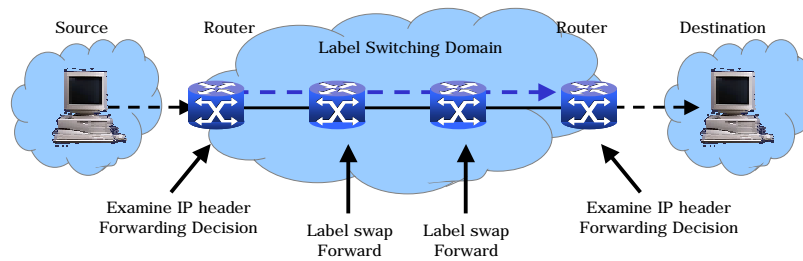
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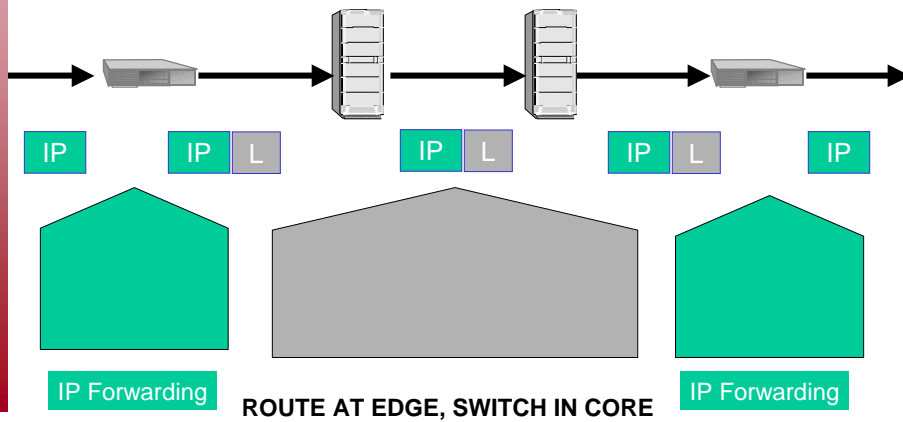
IP Forwarding Scenario



Label Switching



Label Switching - Illustration



Industry Standards

To achieve such performance on switching various companies came forward with their proprietary standards.

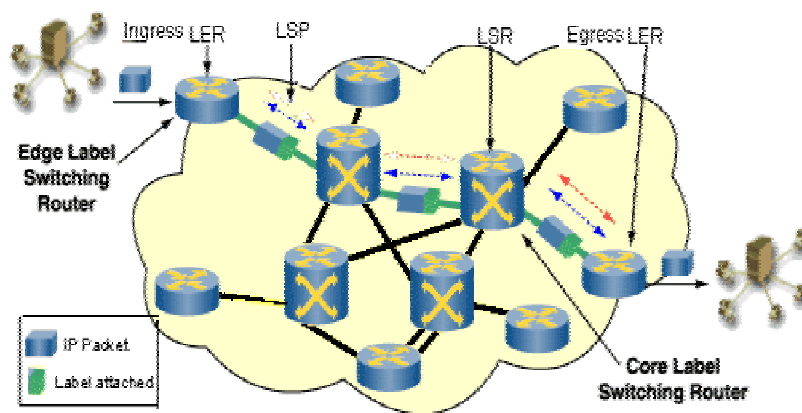
- Cisco's "Tag Switching"
- IBM's "ARIS"
- Toshiba's "Cell Switched Router"

Later IETF standardized this technology into Multi-Protocol Label Switching (**RFC 3031**) and currently a WG-MPLS is working on future enhancements.

Motivation Behind MPLS

- MPLS improves internet scalability by eliminating the need for each router and switch in a packet's path to perform traditionally redundant address lookups and route calculation.
- Improves scalability through better traffic engineering. This should allow more deterministic, or predictable service requirements and performance that can be used to guarantee the QoS.

MPLS Architecture



MPLS Components ...

- FEC (Forward Equivalence Class)–A Class defined for a group of packets having same destination within the MPLS domain.
- Label- an identifier which is used to classify a packet with respect to its FEC.
- Label Switching Router (LSR) - a router capable of label swapping and could be capable of forwarding native Layer 3 packets.
- Label Switched Path (LSP) - the path through one or more LSR's followed by the packets in a particular FEC.



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MPLS Components ...

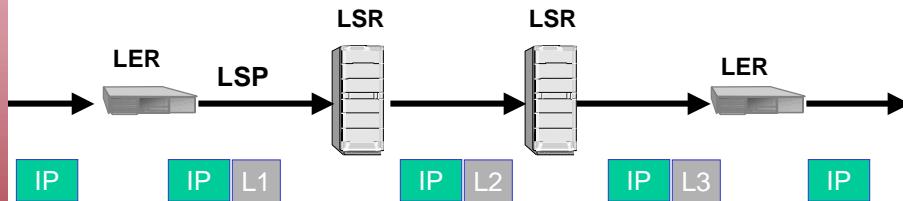
- Label Edge Router (LER) - an LSR node that connects an MPLS domain with a node which is outside of the domain.
- Ingress LER - an LER node in its role in handling traffic as it enters the MPLS domain.
- Egress LER - an LER node in its role in handling traffic as it leaves an MPLS domain.



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Label Swapping illustration



- Labels L1 are swapped with another label L2
- Label swapping is done at each LSR while the packets move across the LSP.

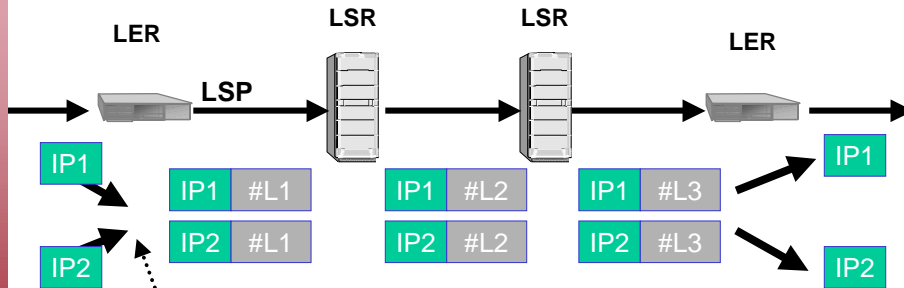
Label Scope

Each label is unique only on the particular LSR/ LER

The label scope can be either per

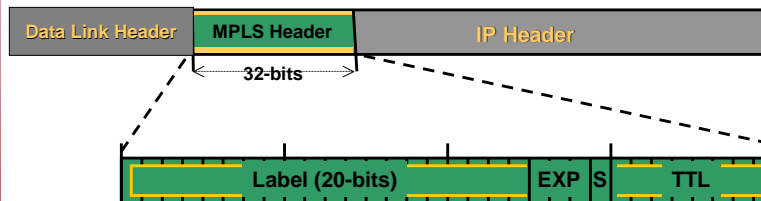
- Platform based
The label scope would be unique on the particular LSR / LER
- Interface based
The label scope would be unique on a specific interface of the particular LER / LSR

Forward Equivalence Class



- FEC = "A subset of packets that are all treated the same way by a router"
- In conventional routing, a packet is assigned to a FEC at each hop (i.e. L3 look-up), in MPLS it is only done once at the network ingress.

MPLS Header



MPLS Header Fields – 4 Octets

- Label - 20 bits
- Experimental bits – 3 bits
- Stacking bit - 1 bit
- Time to Live - 8 bits

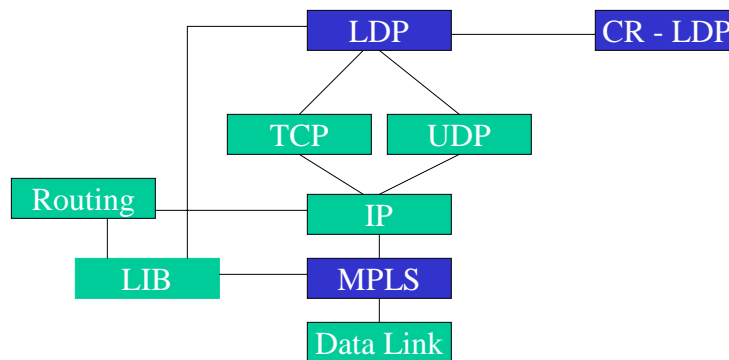
IP packet is encapsulated by ingress LSR

IP packet is de-encapsulated by egress LSR

Label Distribution Protocols

- It is set of procedures by which one LSR informs another LSRs of the bindings (label/FEC) it has made.
- There exists many different distribution protocols
 - [MPLS- BGP]
 - [MPLS-RSVP]
 - [MPLS-RSVP-TUNNELS]
 - [MPLS-LDP]

MPLS Stack



MPLS in a Nutshell

MPLS is all about

- Formation of LSP using Label Distribution
- Switching based on Labels.
- Traffic Engineering using Forward Equivalence Class (FEC).
- MPLS is Layer 2.5 protocol
- "Multi-Protocol" as it can encapsulate any of Layer 3 Protocols.



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