School of Electronic Engineering - DCU
Broadband Switching and Systems Laboratory

Bandwidth Management in MPLS Networks

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Current status of communication networks

"Before building the network of the future, we must first understand what exist." S. Keshav

The telephone network

Offers end-to-end quality-of-service guarantees.

The Internet

Is more flexible and cheaper.

Motivation

We all expect something more from communication networks.

Internet users:

want better Internet services.

Internet Service Providers:

want to be able to provide better services.

Approaches

Design a network that combines:

– *the flexibility and low cost of the Internet*

with

– *the end-to-end quality-of-service guarantees of the telephone network.*

1. Create a new network:

   ATM (Asynchronous Transfer Mode)

2. Add quality-of-service mechanism to the Internet.

Bandwidth Management

controls the bandwidth allocated to applications, users, and organizations sharing the same intranet or Internet link

A good Bandwidth Manager should:

1. enable full control of network traffic
2. ensure the availability of bandwidth for critical applications
3. increase network efficiency and reduce traffic congestion

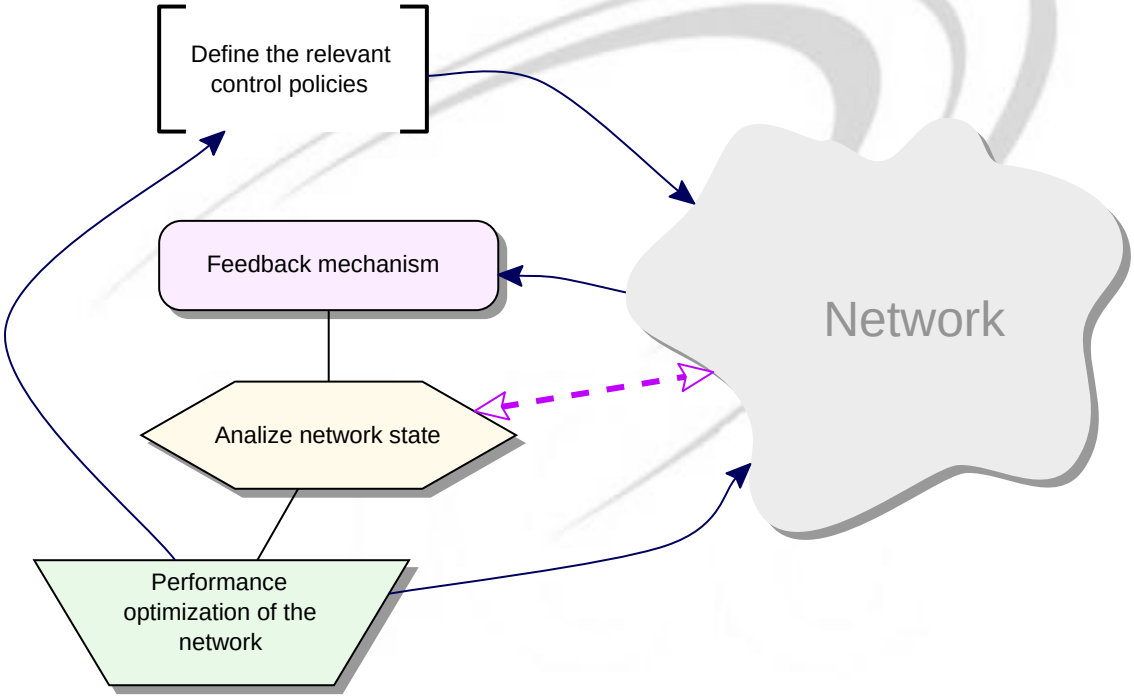
Traffic Engineering (TE)

measuring and optimizing the performance of operational networks

The key goals of TE:

- minimization of packet loss
- minimization of delay
- maximization of throughput
- enforcement of Service Level Agreements (SLAs)

Traffic Engineering Process Model



Label Switching paradigm

IPv4 Longest Prefix Match

Address	*Mask*	*OUT Interface*
136.206.0.0	**255.255.0.0**	**eth0**
136.231.0.0	255.255.0.0	eth1
136.206.35.0	**255.255.255.0**	**eth2**
136.206.35.101	**255.255.255.224**	**eth3**

136.206.35.101 = 10001000.11001110.00010011.01100101

11111111.11111111.00000000.00000000

11111111.11111111.11111111.00000000

11111111.11111111.11111111.11100000

Exact Match

Label IN	IN interface	Label OUT	OUT interface
21	eth0	88	eth1
34	eth1	100	eth2
56	eth0	27	eth3

Labeled packet

...	34	...

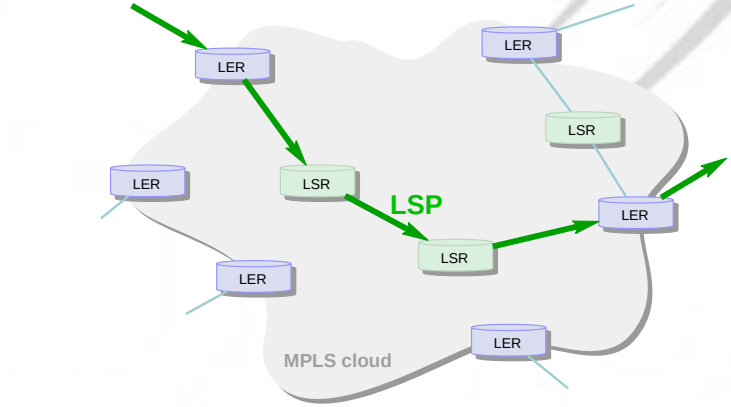
MultiProtocol Label Switching (MPLS)

Emerged from:

- *need for a faster routing mechanism for IP*

  and

- *need to provide ATM switches with the control and scalability of a* layer3 *router*



LSR - Label Switch Router
LER - Label Edge Router
LSP - Label Switch Path

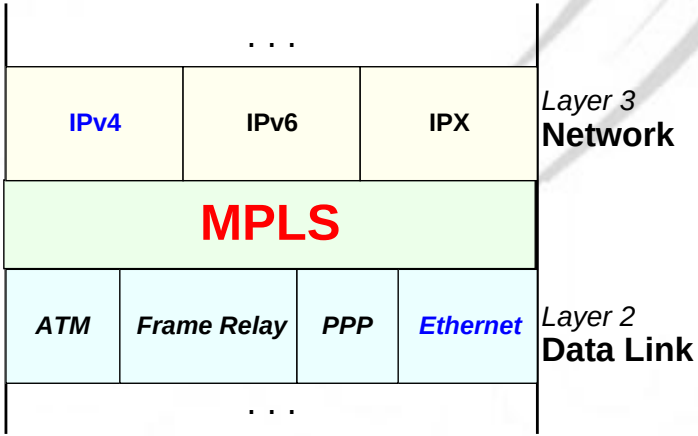
MPLS & Traffic Engineering

MPLS is useful for TE in the specific aspects of measurement and dynamic control of Internet traffic.

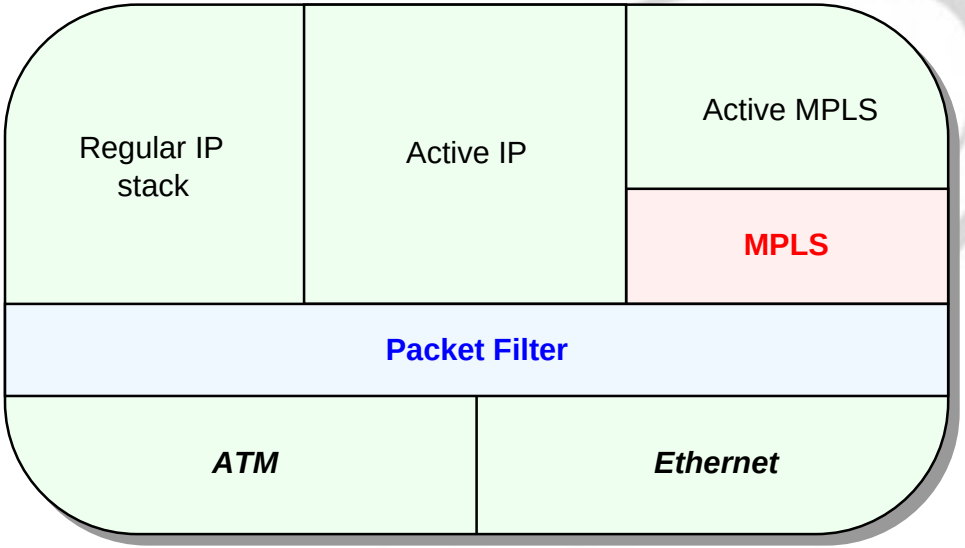
- the path (LSP) followed by a packet is determined at the ingress of an MPLS domain
- TE provided using *explicit routed* paths
- LSPs are independently created based on user-defined policies
- RSVP-TE and CR-LDP are two possible approaches to supply dynamic traffic engineering and QoS

Using MPLS to integrate IP with ATM & Frame Relay

Combine Layer 2 switching & Layer 3 routing



Our project



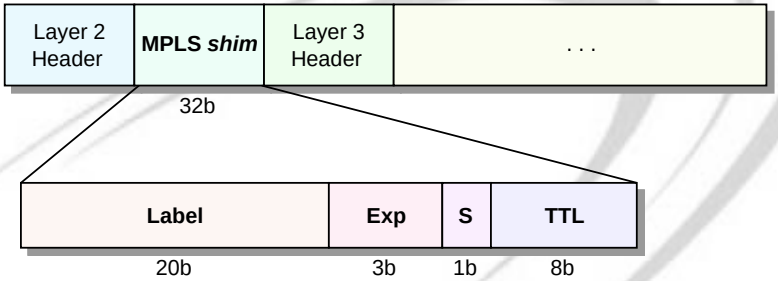
Networking Software

Packet Filter

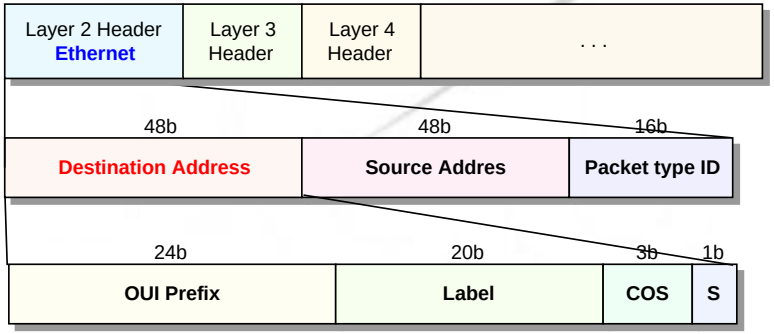
Device Drivers

Implementing MPLS in Linux

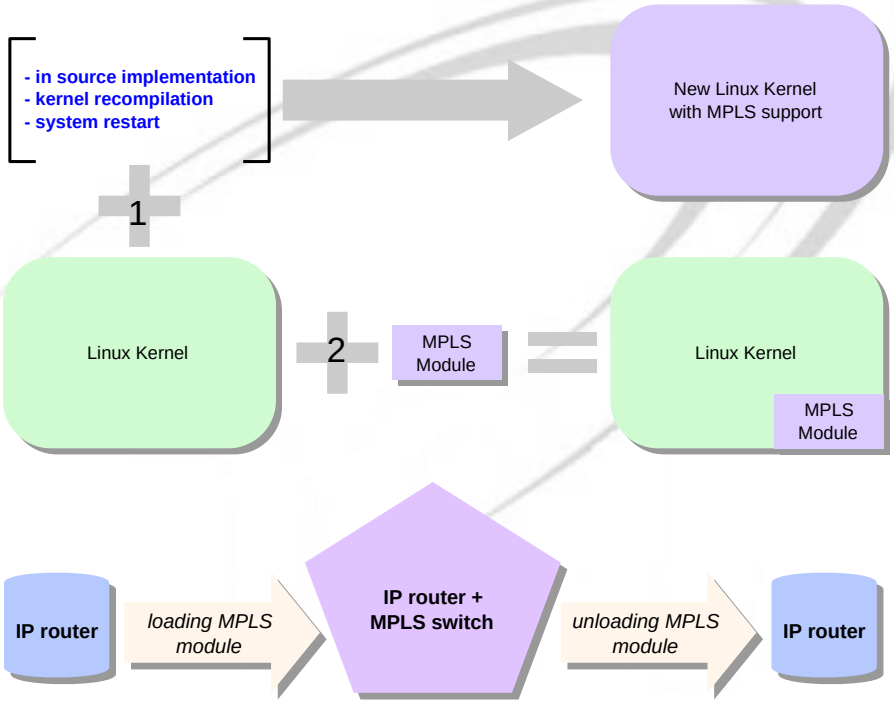
Standard approach



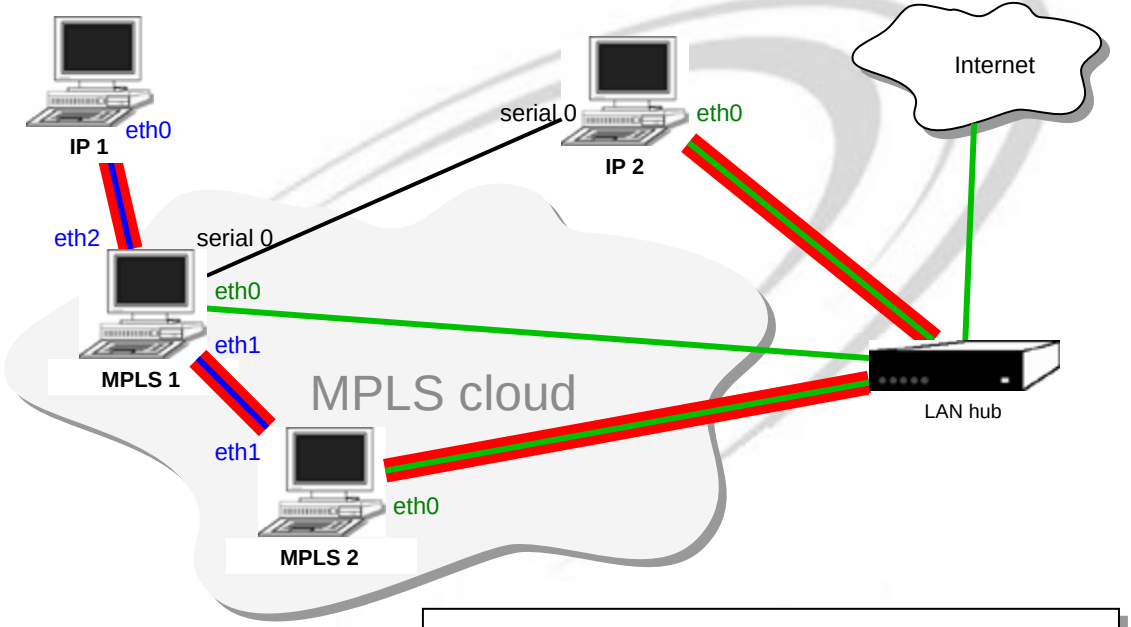
Our approach



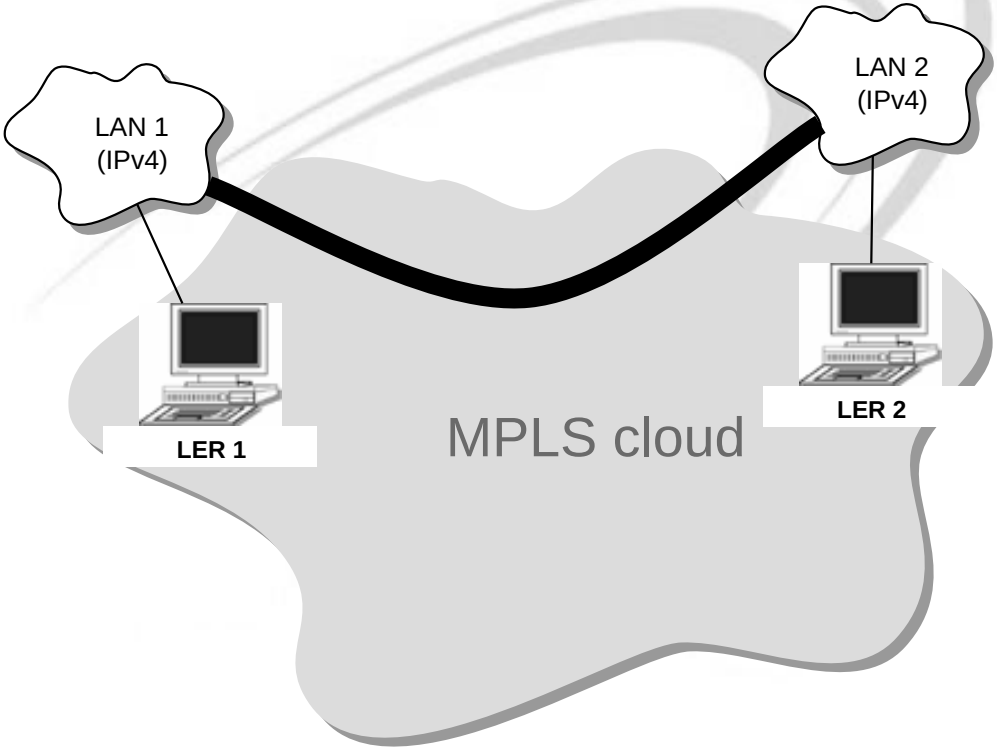
Advantages of using MPLS as a module



Network test suite



Simplified network test suite



Conclusions & future work

Implementing MPLS

– understanding Linux OS internals

– understanding label switching paradigm and MPLS concepts

– useful research tool for future work (traffic engineering, bandwidth management, etc.)

Future work

Signaling protocol for our *vanilla* MPLS implementation

Perform traffic engineering tasks using MPLS environment