Lecture Computer Networks

Multi Protocol Label Switching (MPLS)

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Connection-Oriented and Connectionless Networks

Advantages of a connection-oriented network:

- resource reservation is possible ➔ Quality of Service
- no address lookup for every packet ➔ greater efficiency
- predictability and stability

Advantages of a connectionless network (e.g. IP):

- flexibility (see Internet)

What is MPLS?

- MPLS stands for Multiprotocol Label Switching
- It applies connection-oriented properties to IP networks by tagging IP packets with "labels" that specify a route and priority
- the label can represent
  - the combination of a “Forwarding Equivalence Class“ and a precedence or class of service
  - the route in the MPLS network

Standard: RFC3031 of IETF, http://www.ietf.org/rfc.html

Goals

- Standardization of a basic technology that integrates the label switching forwarding paradigm with network layer routing
- Improvement of the price / performance of network layer routing
- Improvement of the scalability of the network layer
- Providing a greater flexibility in the delivery of (new) routing services by allowing new routing services to be added without a change to the forwarding paradigm

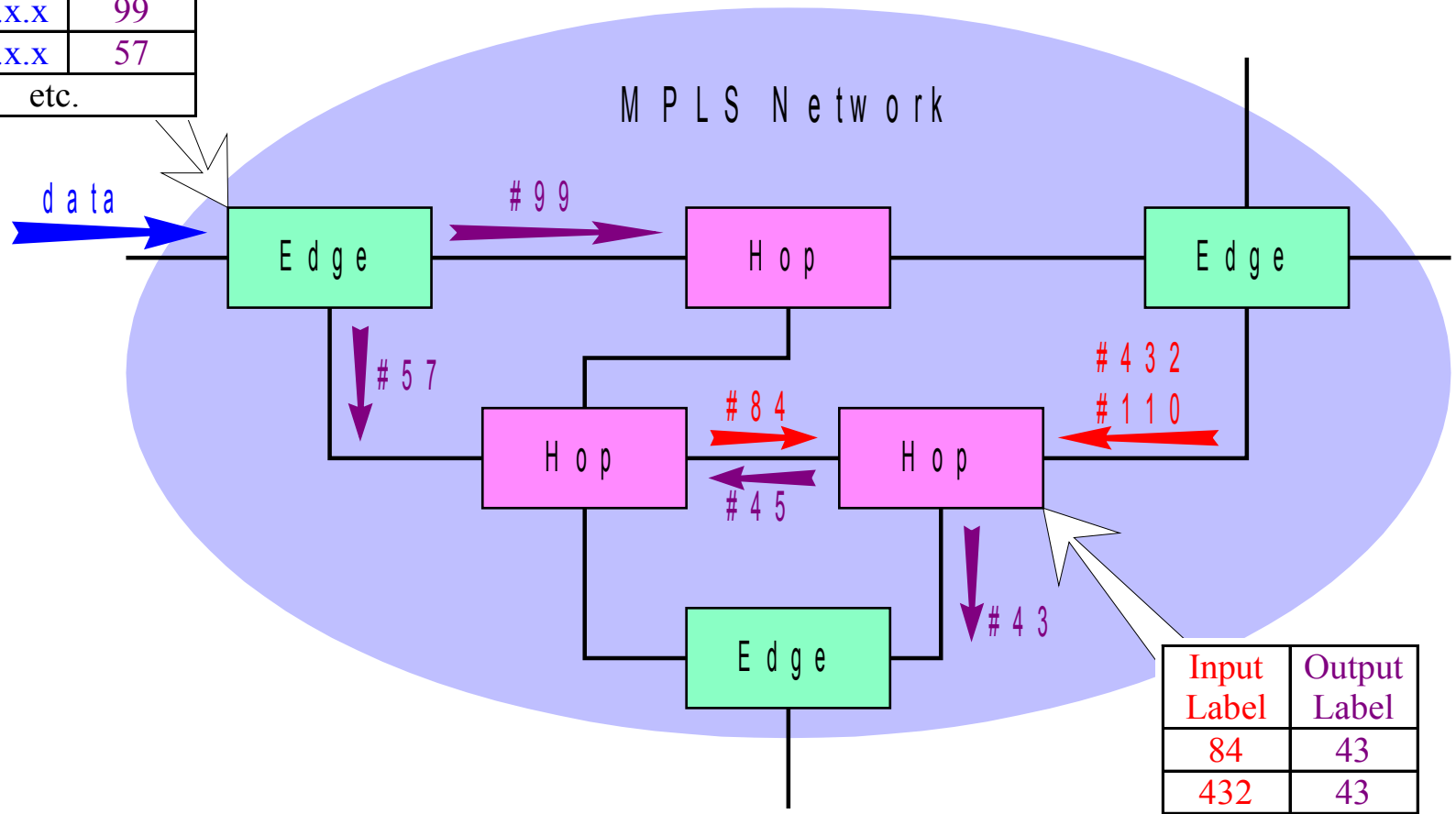
How does MPLS work?

- A packet enters an MPLS network
  - the destination address is looked up on the routing table
  - yielding the output port and a label

- all hops inside the MPLS network look up in a label table the next hop and the new label

Example

Dest. Address	Output Label
10.1.x.x	99
10.2.x.x	57
etc.	



Input Label	Output Label
84	43
432	43
110	45
etc.	

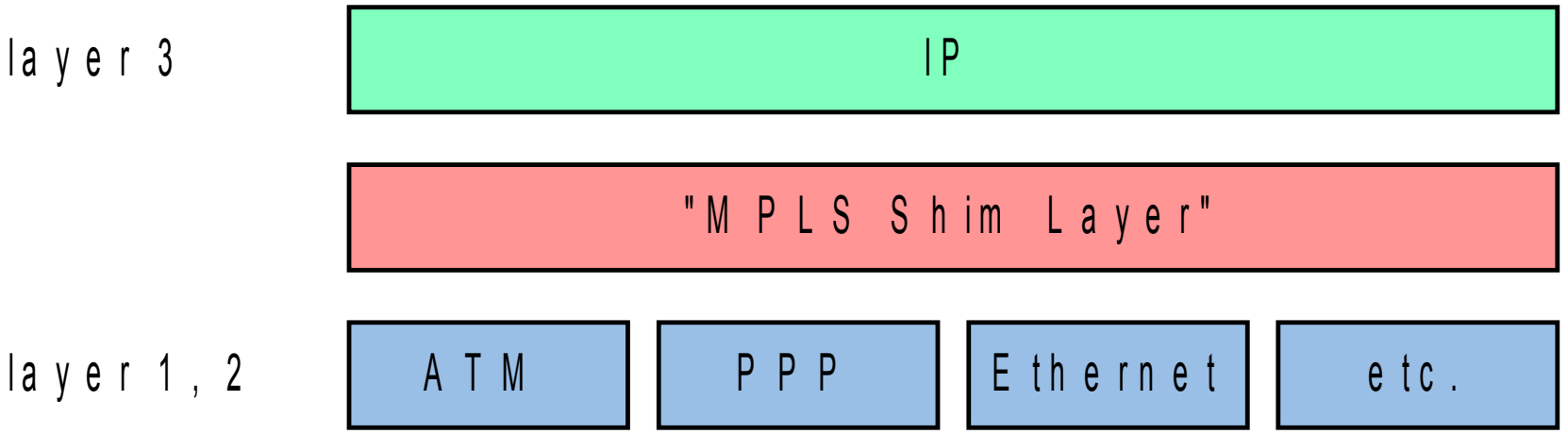
MPLS Link Layers

MPLS is intended to run over multiple Link Layers

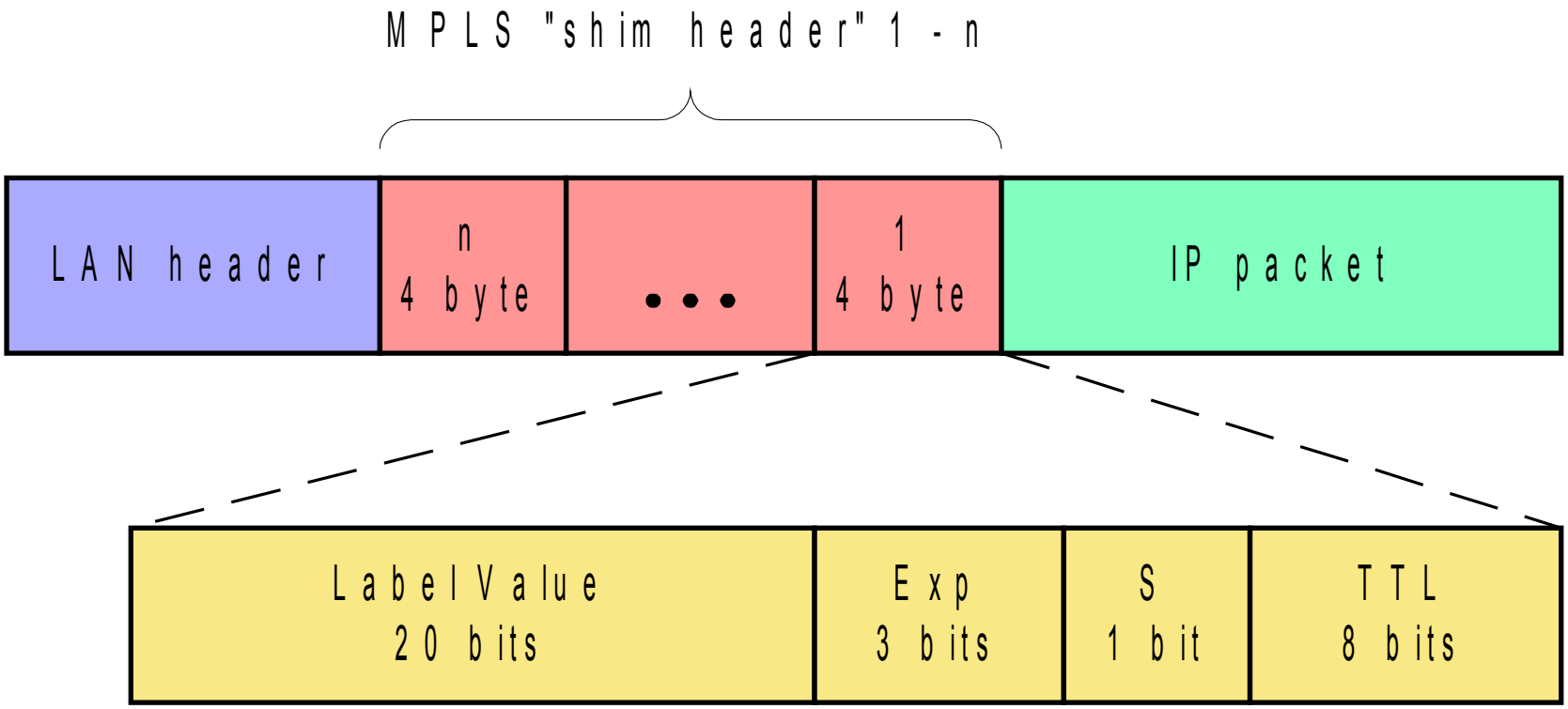
Specification for the following link layers currently exists:

- ATM: first label can be contained in VCI/VPI field of ATM header; label stack placed in PDU
- Frame Relay: label contained in DLCI field in FR header
- PPP/LAN: uses „shim header“ inserted between layer 2 and layer 3 headers

The Shim Layer



MPLS Encapsulation - LAN Link Layer



Exp: Experimental Use

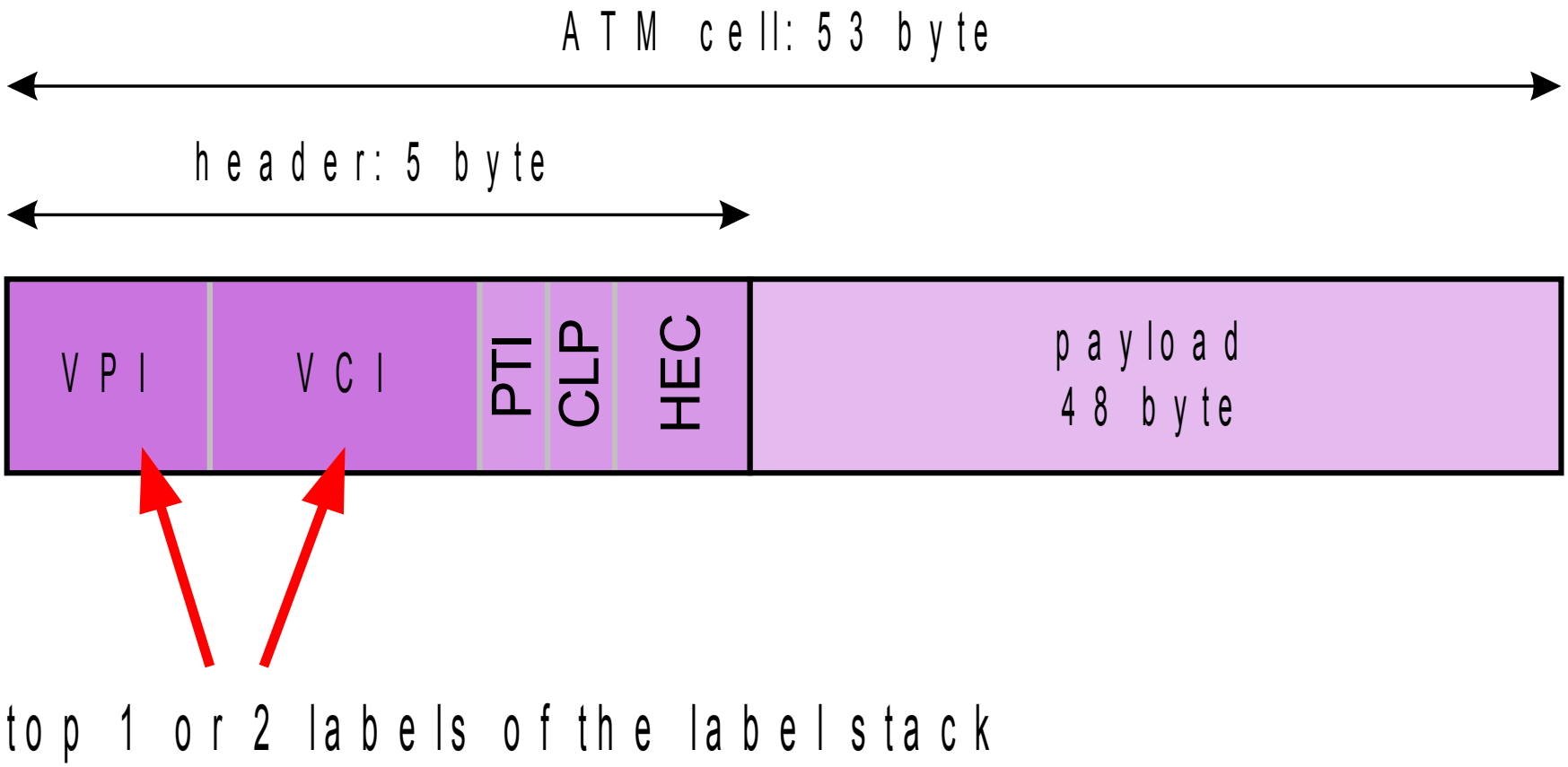
S: Bottom of Stack

TTL: Time to Live

Label Value

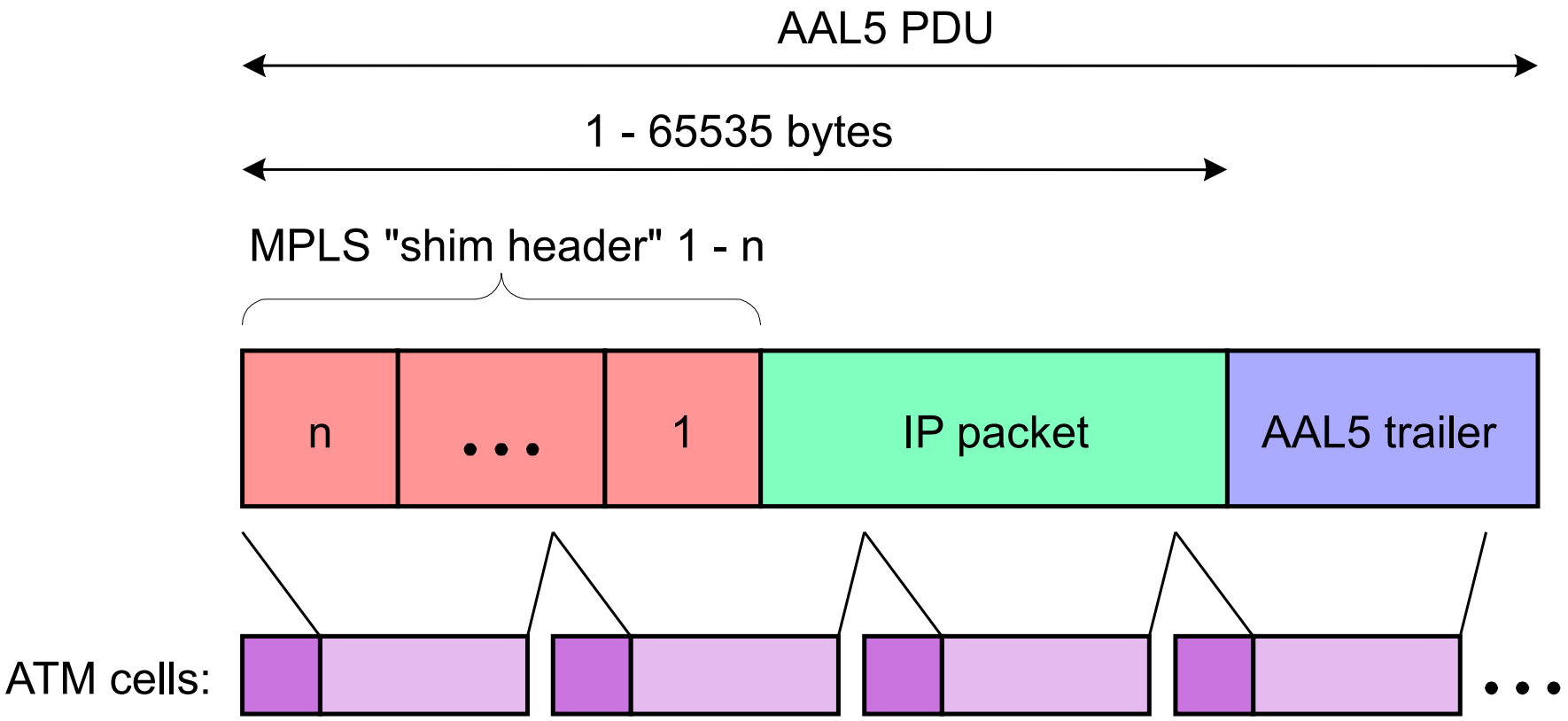
- A 20 Bit field carrying the current value of the label
- When a labeled packet is received, the label value at the top of the stack is looked up.
  As a result of a successful lookup one learns
  - the next hop to which the packet is to be forwarded
  - the operation which has to be performed on the label stack before forwarding

MPLS Encapsulation - ATM I



MPLS Encapsulation - ATM II

PDU (Protocol Data Unit) of AAL5 CS (Convergence Sublayer):



MPLS Terminology

- LDP: Label Distribution Protocol
- LSP: Label Switched Path
- FEC: Forwarding Equivalence Class
  (A subset of packets that are all treated the same way by a router)
- LSR: Label Switching Router
- LER: Label Edge Router (Useful term not in standards)