IP6 Protocol Walkthrough

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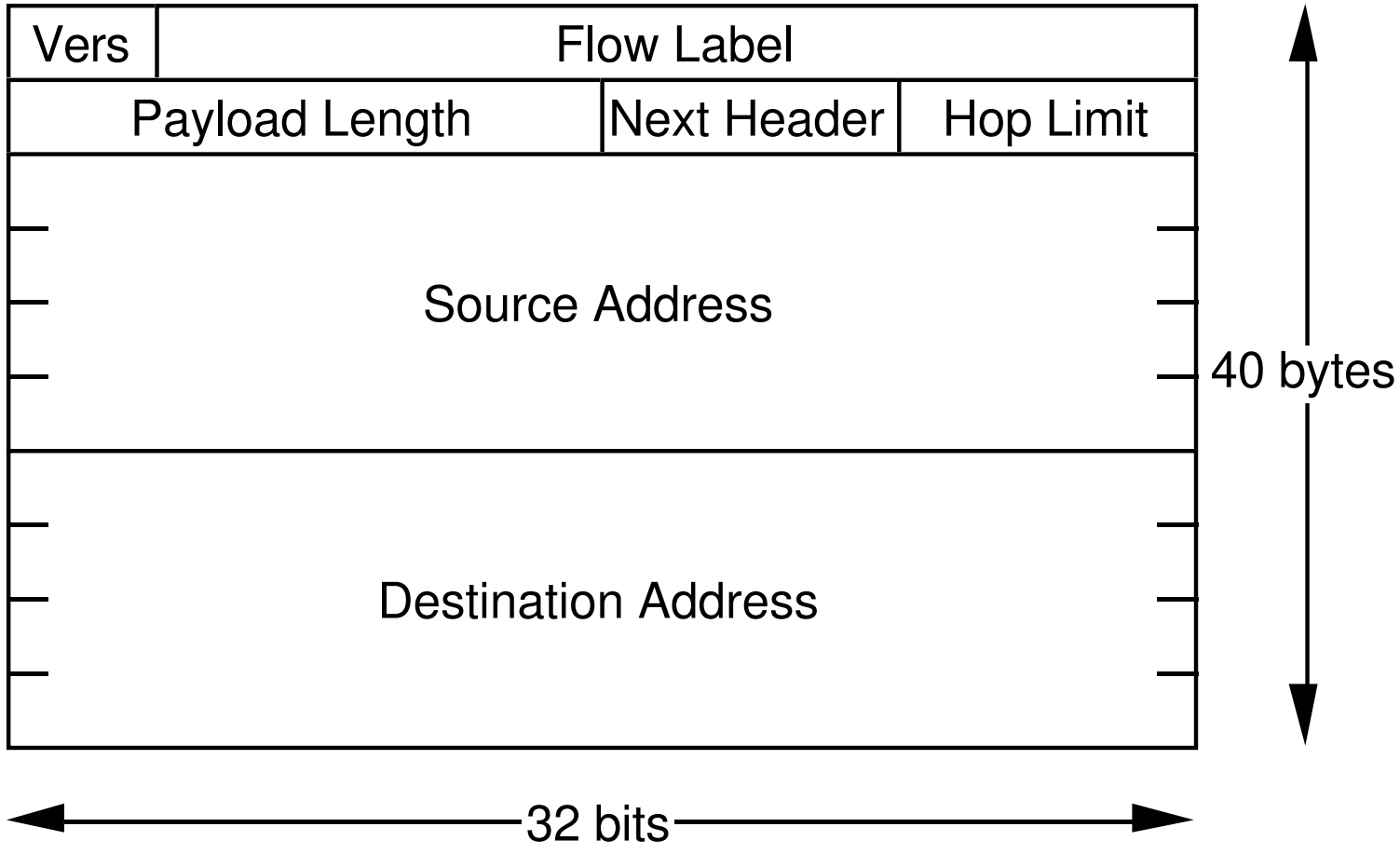
A New Version of IP

- expanded addressing capabilities
- streamlined header format
- improved support for options / extensions
- flow labeling capabilities

The IP6 Header



Header Changes from IP4

- addresses increased from 32 to 128 bits
- fragmentation fields moved out of base header
- header checksum eliminated
- header-length field eliminated
- length field excludes IP6 header
- Time-to-Live —> Hop Limit
- Protocol —> Next Header
- TOS replaced by Flow Label
- alignment changed from 32 to 64 bits

Extension Headers

IP6 header *Next Header = TCP*	TCP header + data

IP6 header *Next Header = Routing*	Routing header *Next Header = TCP*	TCP header + data

IP6 header *Next Header = Routing*	Routing header *Next Header = Fragment*	Fragment header *Next Header = TCP*	fragment of TCP header + data

Extension Headers (cont.)

- processed only by node identified in IP6 Destination field => much lower overhead than IP4 options

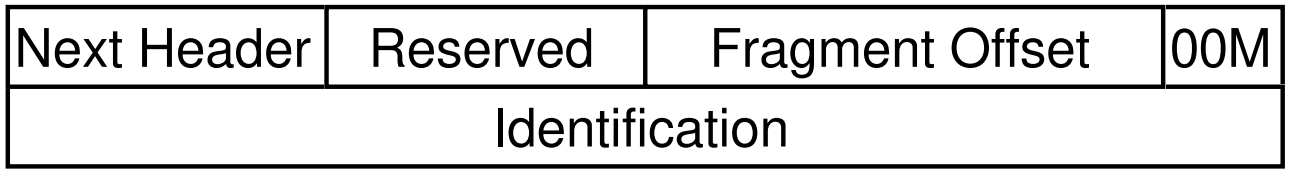
  exception: Hop-by-Hop Options header

- eliminated IP4's 40-byte limit on options; in IP6, limit is total packet size (or Path MTU in some cases)

- currently defined extension headers:

  Hop-by-Hop Options, Routing, Fragment,
  Authentication, Security, End-to-End Options

Fragment Header

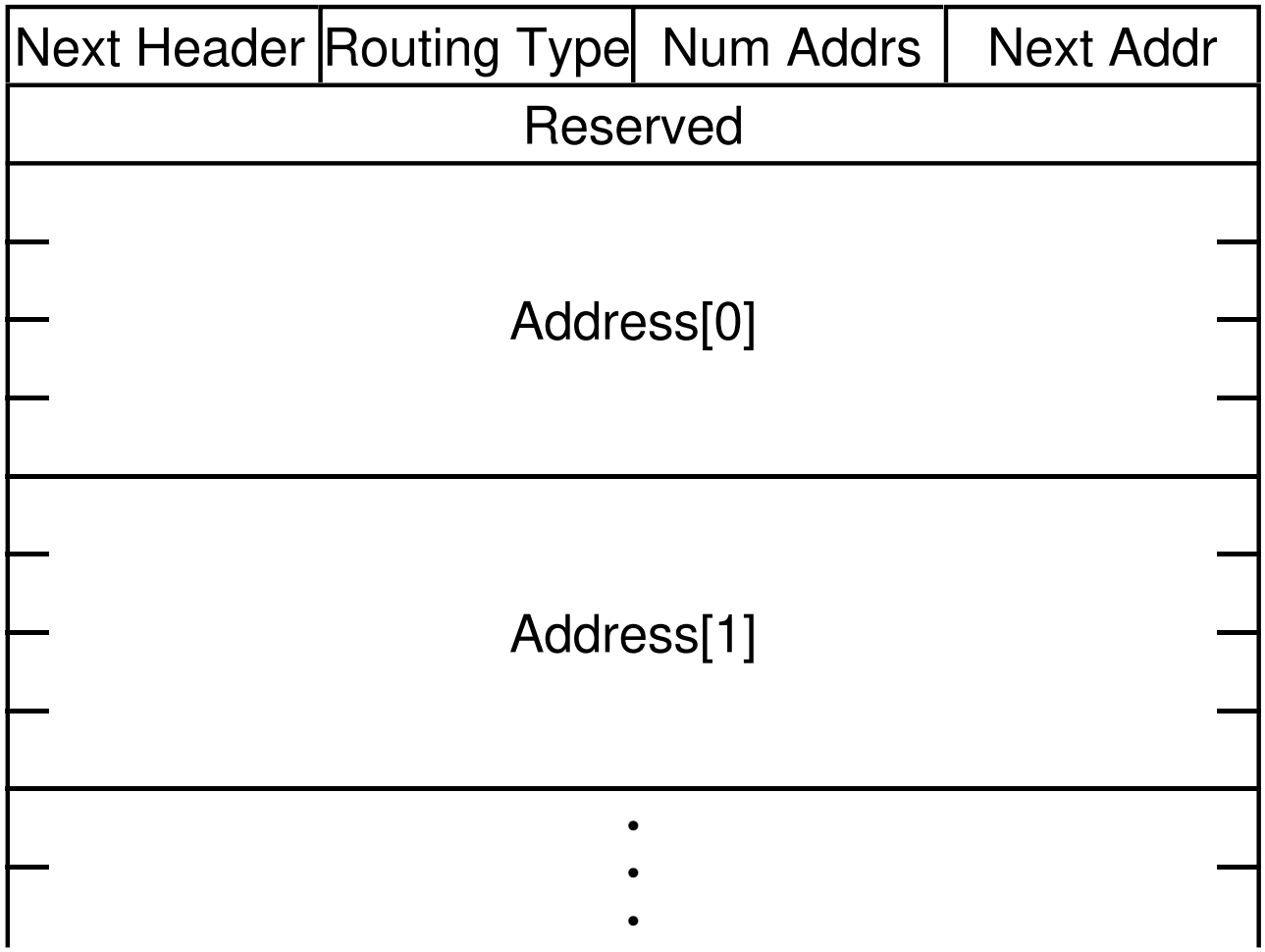


- same fragmentation algorithm as IP4 (e.g., fragment only on 8-byte boundaries)
- longer Identification field handles more packets in transit
- all IP6 nodes perform Path-MTU Discovery
  - — Fragment header present only when needed
  - — fragmentation is **end-to-end**, routers never fragment a packet in transit

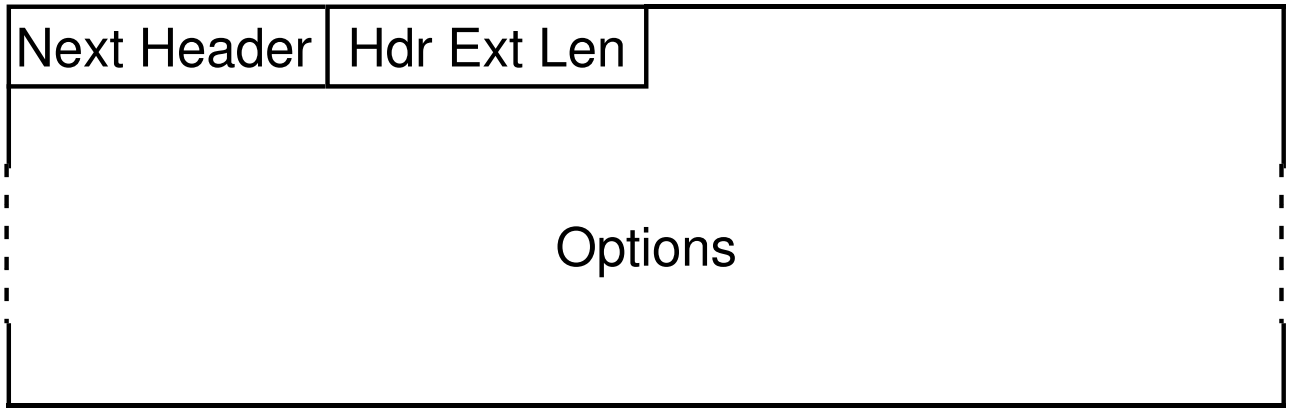
Packet Size Issues

- minimum link MTU increased from 68 to 576 bytes
- links with MTU < 576 (if there are any) must do link-layer fragmentation and reassembly
- minimal IP6 implementations (e.g., in a boot ROM) may omit PMTU Discovery and fragmentation code by limiting all packets to ≤ 576 bytes

Routing Header



Hop-by-Hop Options Header & End-to-End Options Header



act as containers for TLV-encoded options:

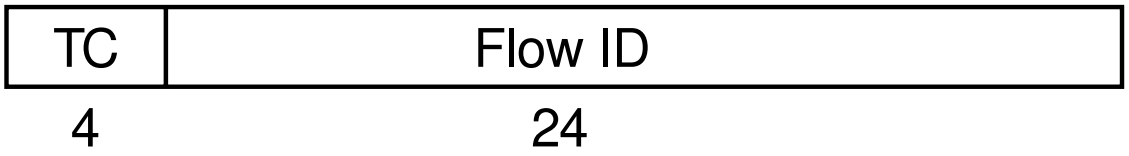
Options

high-order bits of Option Type encode required action if not recognized:

00 — skip over option
01 — discard packet
10 — discard packet & send ICMP Unrecognized Type to source
11 — discard packet & send ICMP Unrecognized Type to source **only if** destination was not multicast

- eases introduction of future options
- only currently-defined options are Pad options, for internal and external alignment

Flow Label



TC (traffic class)

0-7 are time-sensitivity of flow-controlled traffic

8-15 are drop priority for non-flow-controlled traffic

Flow ID is random value; when combined with IP6 source address, uniquely identifies traffic flow