

The Internet/Network Layer

IPv6

- The next approach to the IP address problem is to change IP itself
- The next version of the IP is IPv6 (sometimes called IPng for IP *next generation*)
- Slowly being introduced, but will take a while to supplant IPv4
- 128 bit addresses; CIDR-style allocation

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IPv6 aims

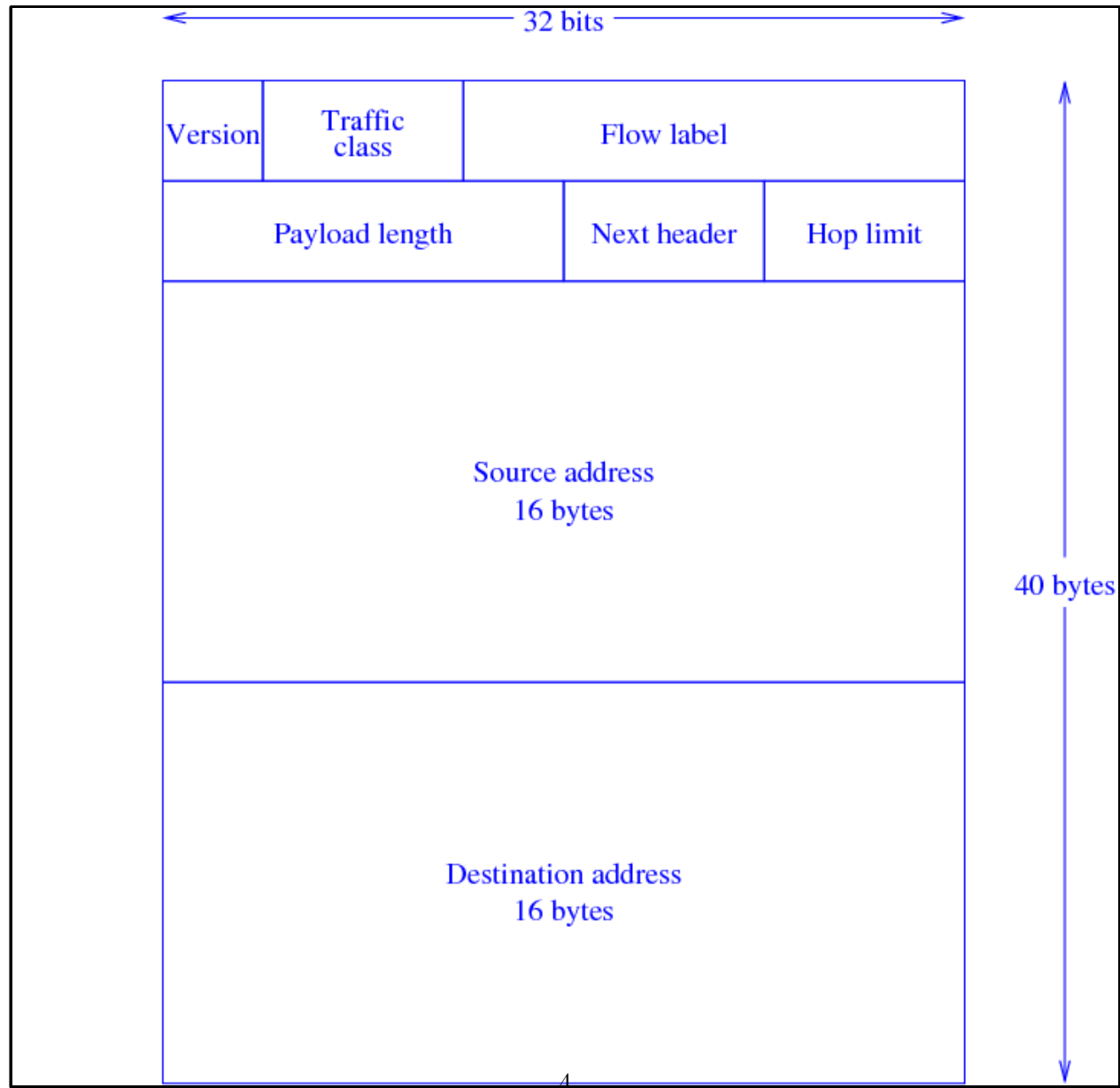
- A larger address space
- Reduce the size of router tables
- Simplify the protocol so routers can process packets faster
- To provide security and authentication
- To pay attention to type of service

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IPv6 aims

- To have better multicasting support
- To have mobile hosts with fixed IP addresses
- To allow room for evolution of the protocol
- To permit IPv4 and IPv6 to coexist during the transition

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IPv6 header

- Version, 4 bits. The number 6. This is identical in position to IPv4 and can be used to distinguish packets in mixed-version environments
- Traffic class, 8 bits. Like TOS (DSCP) in v4
- Flow label, 20 bits. Allows routers to recognise packets in a single *flow* and treat them specially. In essence a virtual circuit

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IPv6 header

- Payload length, 16 bits. The number of bytes following the fixed 40 byte header. Unlike v4, does not include the header in the count
- Next header, 8 bits. Like the protocol field in v4, but also allows for v6 optional header fields, if any
- Hop limit, 8 bits. The TTL field, renamed to make it clear how it is actually used

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IPv6 header

- Source and destination addresses, 128 bits each.

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IPv6 addresses

- Four times as long as v4 addresses
- $2^{128} = 3 \times 10^{38}$ addresses, enough for an address for every molecule on the surface of the Earth
- Unicast; multicast; broadcast and *anycast* addresses: details later

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IPv6 fragmentation

- No fragmentation field. A router never fragments, but drops the packet and sends back a “packet too big” message to the source. The source can then send smaller packets
- Routing is therefore much simpler and faster

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IPv6

- No header length field: the header is always 40 bytes
- No checksum field: there are checksums in other layers and networks are reasonably reliable. Also we don't have to recompute the checksum in every router as the TTL decreases

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IPv6

- v4 has 13 (fixed) fields; v6 has 8; much simpler to process
- v6 addresses are 4 times the size, but the header is only twice as long

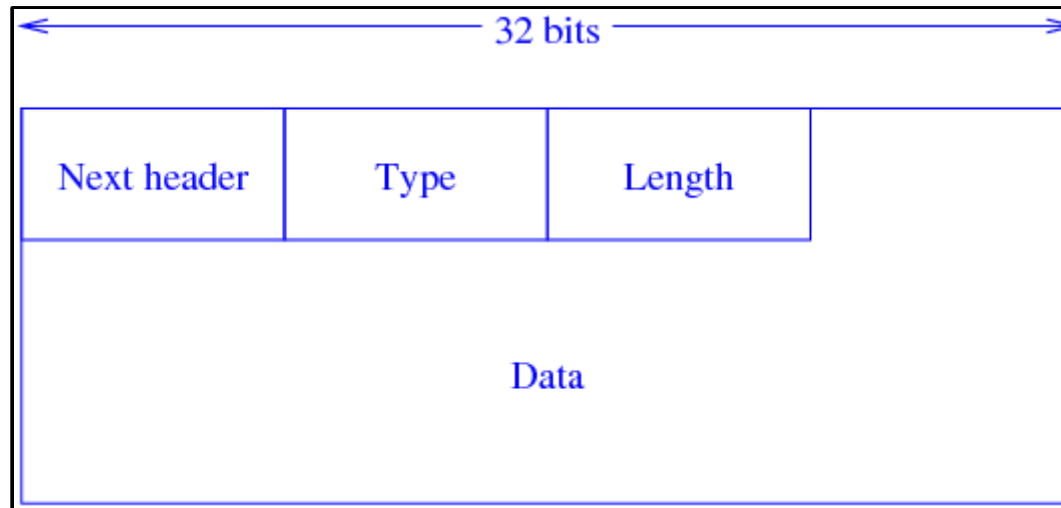
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IPv6 extension headers

- The *next header* field daisy-chains options, called *extension* headers, or gives the protocol of the next layer
- Extension headers are either of fixed length, or have length fields
- A *type* field indicates the kind of header: not all implementations might recognise all types of header, e.g., if a new header type is created

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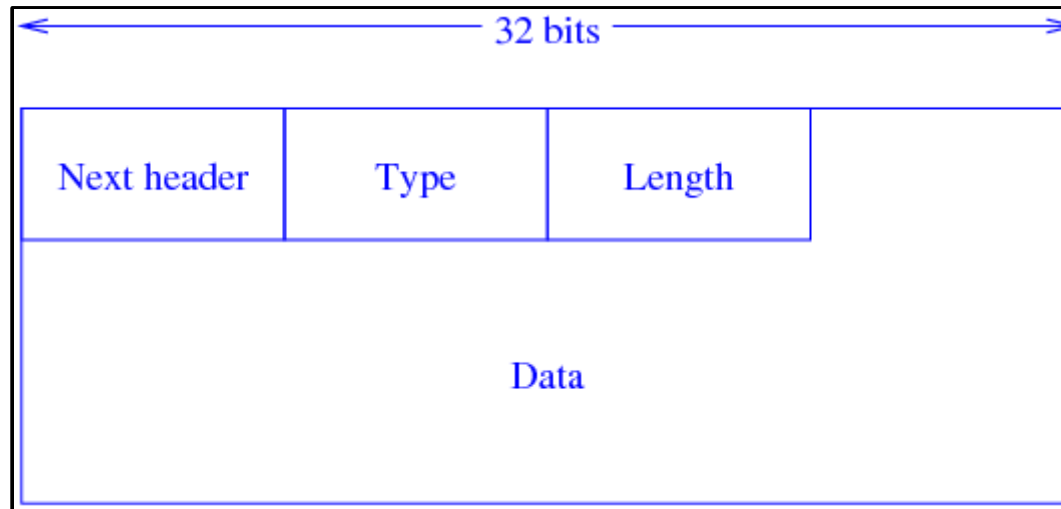
IPv6 extension headers



- The top two bits of the type indicate what to do if the header is not recognised

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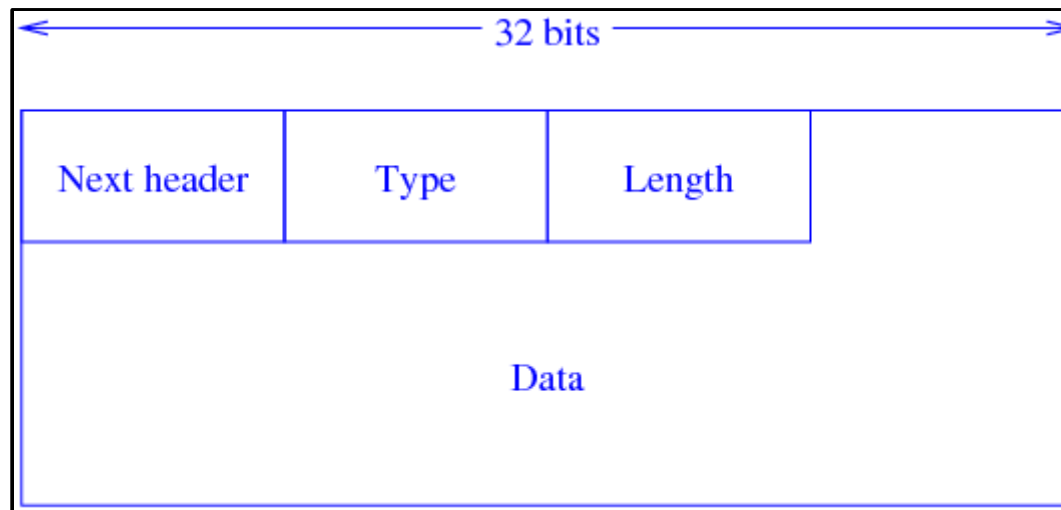
IPv6 extension headers



- 00 skip this option
- 01 discard this packet
- 10 discard this packet and send a error message back to the source

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IPv6 extension headers



- 11 discard this packet and send a error message back to the source if the source was not a multicast address. This is to prevent millions of error messages

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IPv6 extension headers

- Routing options
- Fragmentation management
- Authentication
- Security
- Jumbograms: packets up to 4GB in length!
- And others

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Transition to Ipv6

- Can't turn off the Internet and replace v4 by v6 overnight
- Grow groups of v6-connected machines linked by v4 tunnels
- Groups merge and eventually the entire Internet is v6
- This is taking its time!