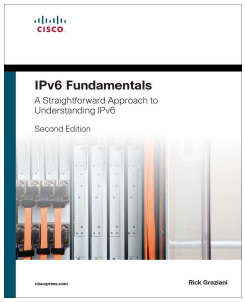

IPv6 Fundamentals, by Rick Graziani

Comparing IPv4 and IPv6

Selected by **Alvaro Barradas** for Redes II

<abarra@ualg.pt>

Chapter 3

Comparing IPv4 and IPv6

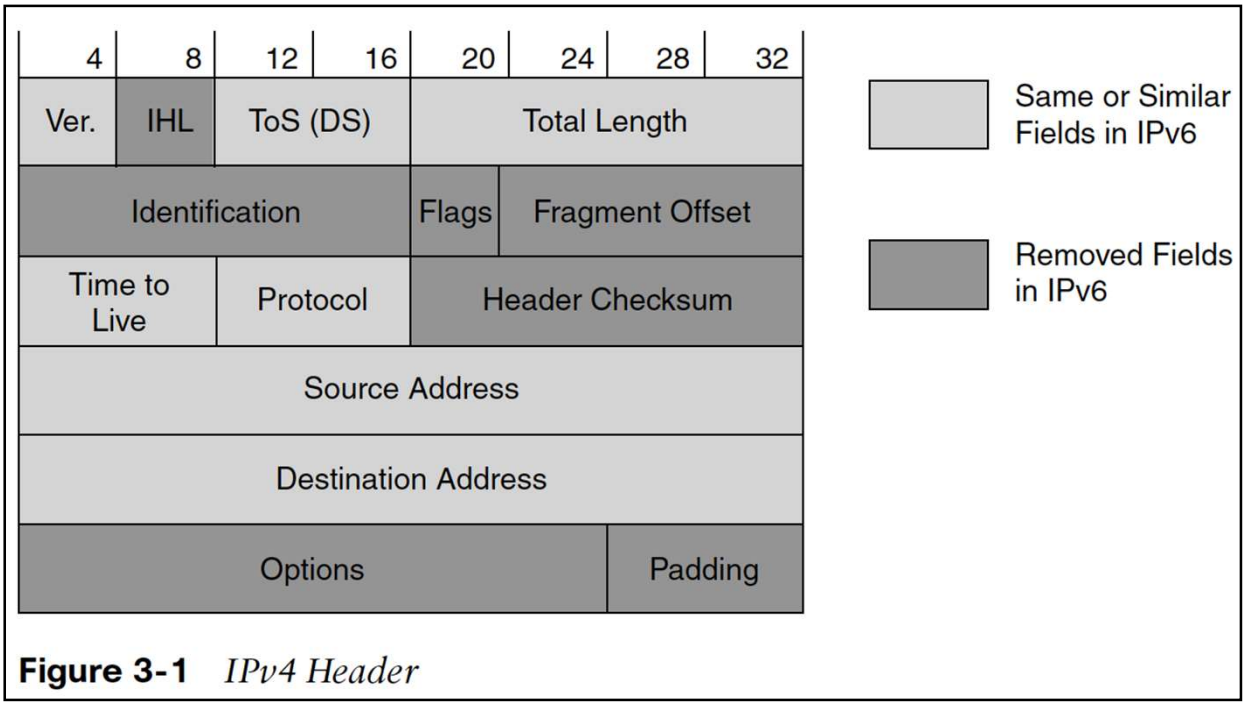

Figure 3-1 *IPv4 Header*

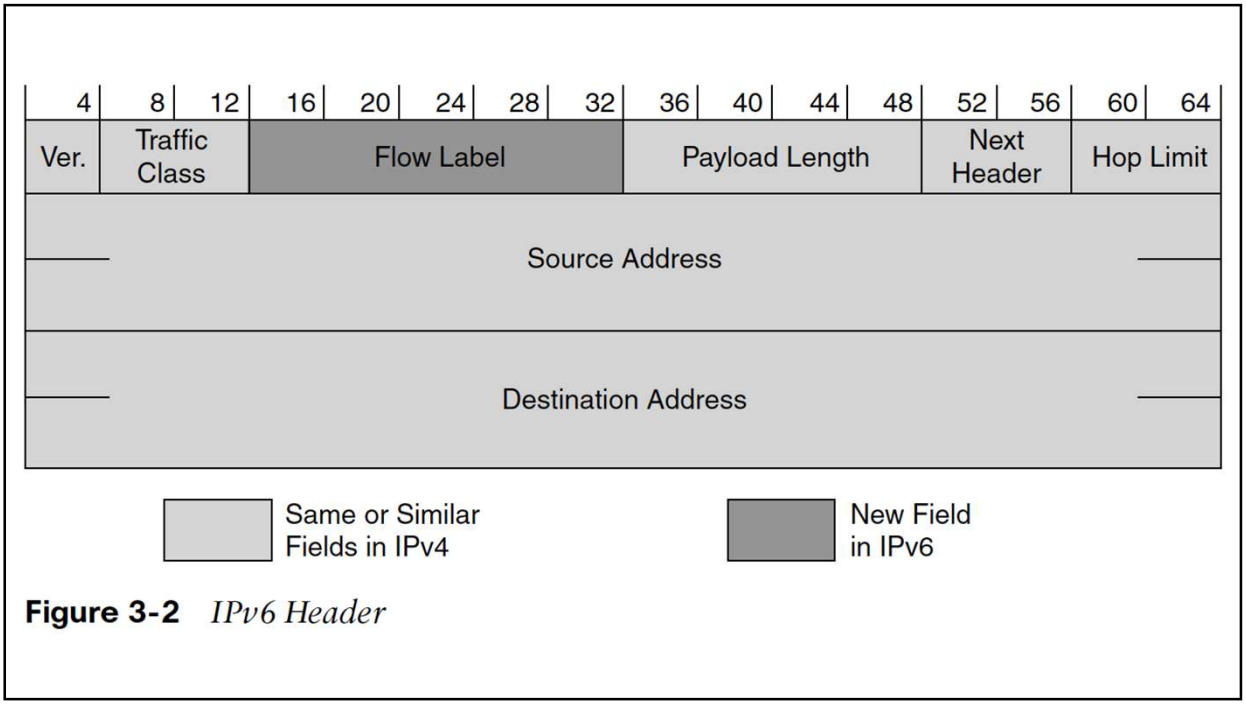

Figure 3-2 *IPv6 Header*

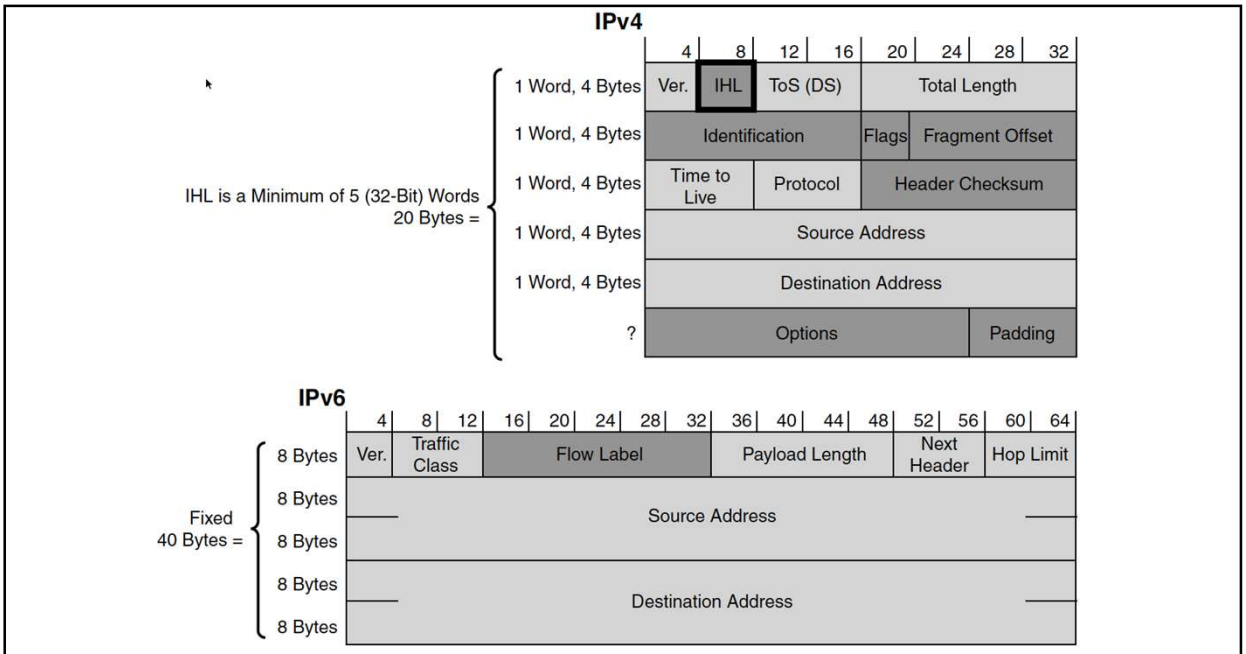

Figure 3-3 *IPv4 Internet Header Length (IHL) Field*

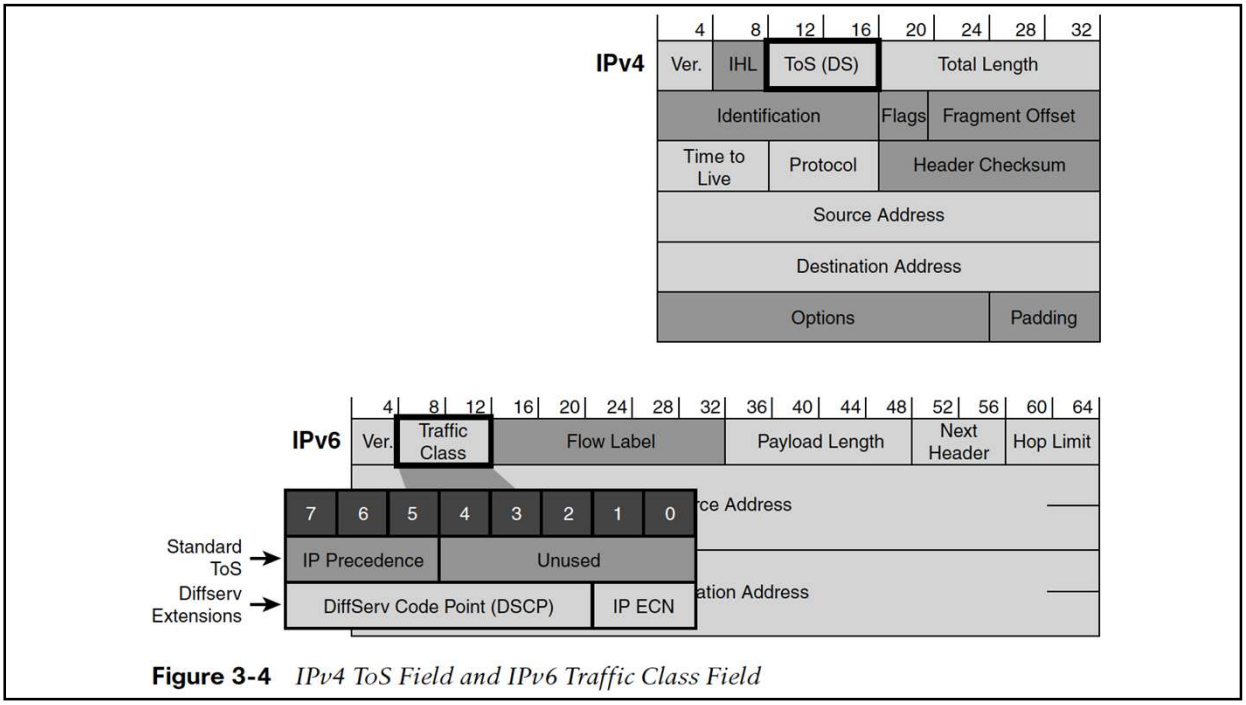

Figure 3-4 *IPv4 ToS Field and IPv6 Traffic Class Field*

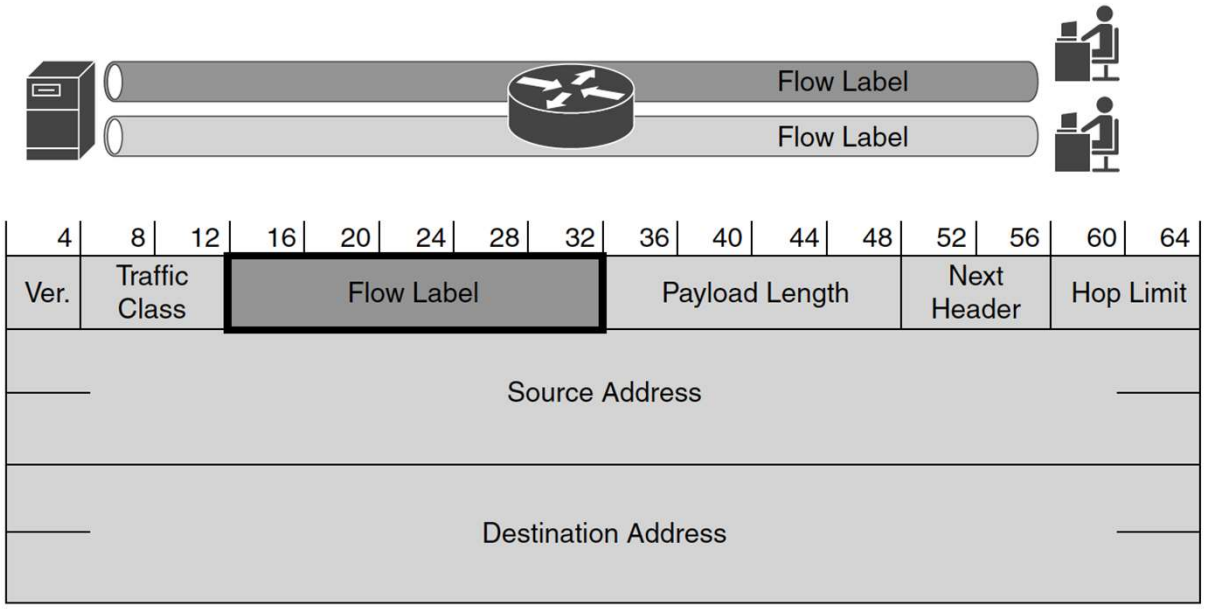

Figure 3-5 *IPv6 Flow Label Field*

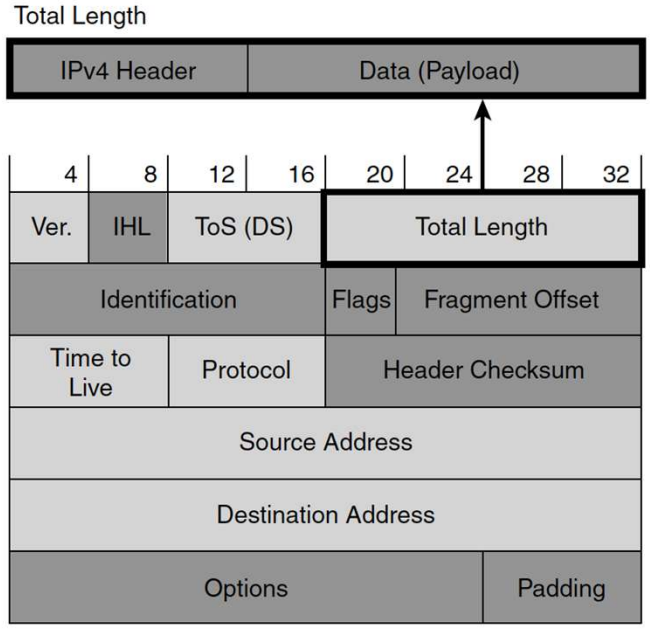

Figure 3-6 *IPv4 Total Length Field*

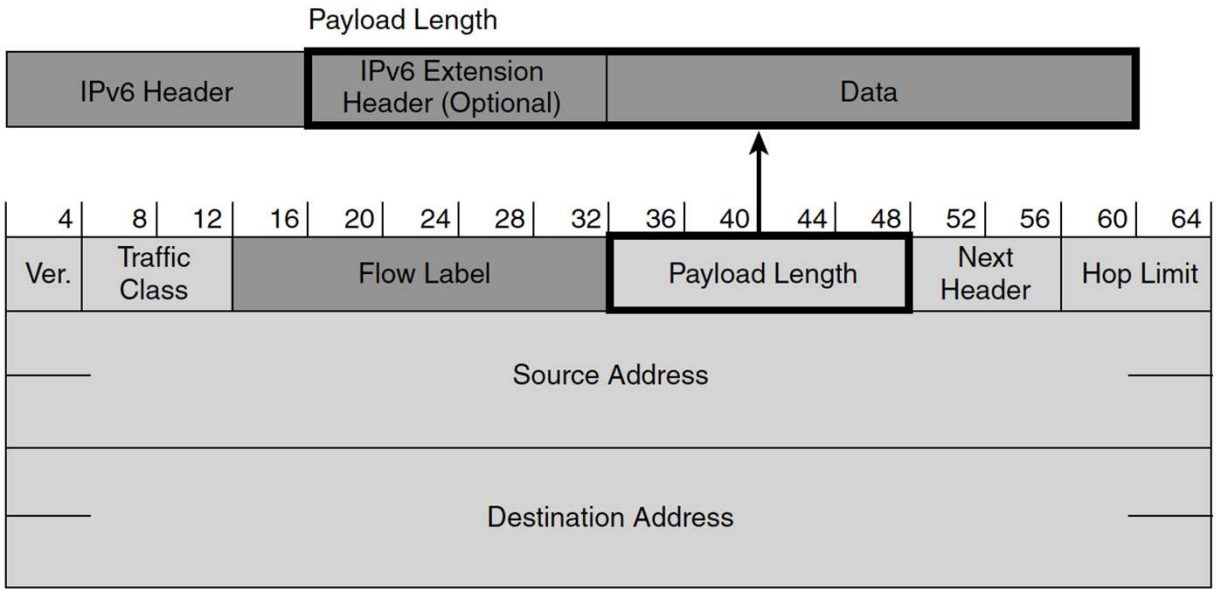

Figure 3-7 *IPv6 Payload Length Field*

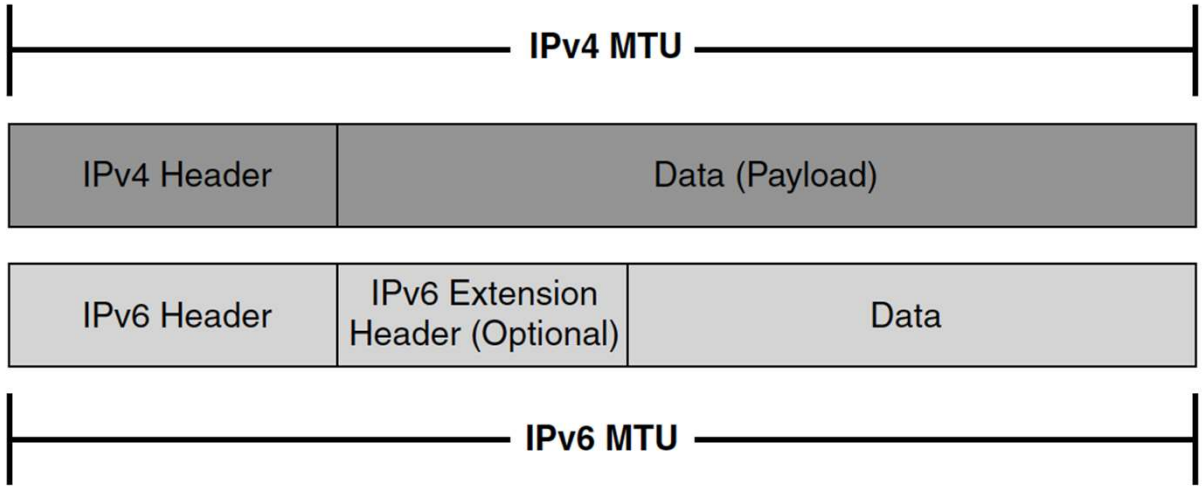

Figure 3-8 *IPv4 and IPv6 MTUs*

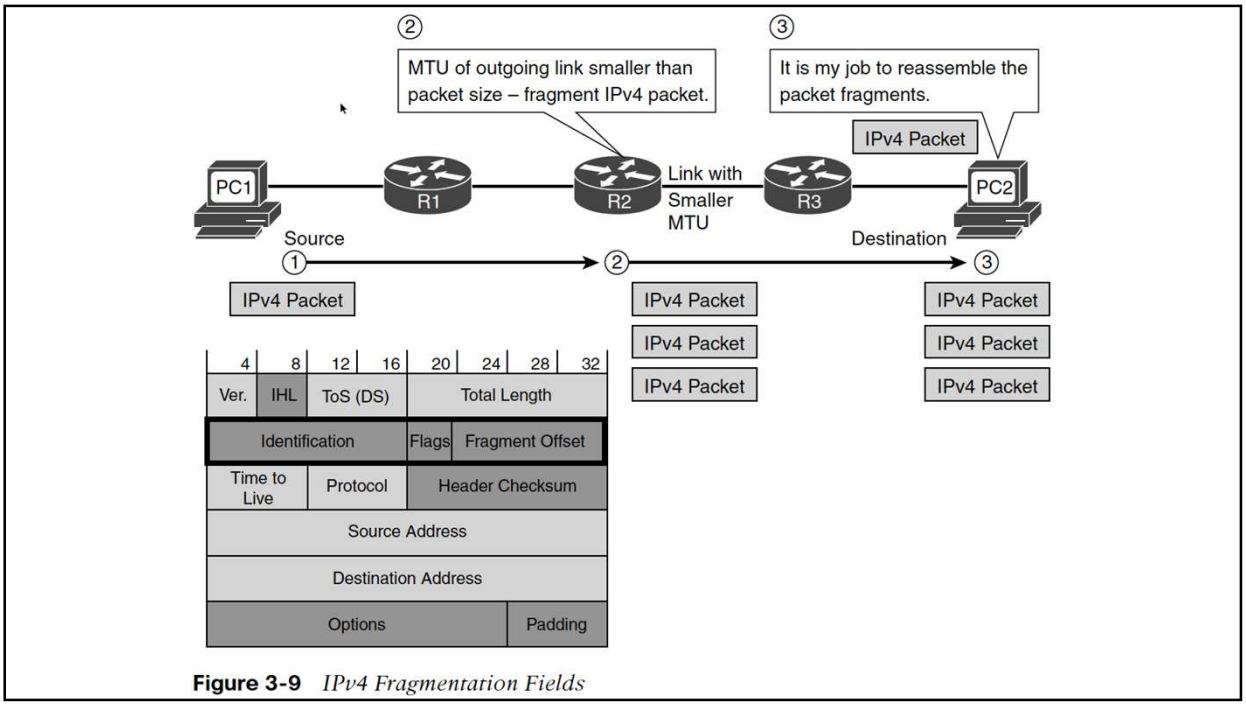

Figure 3-9 *IPv4 Fragmentation Fields*

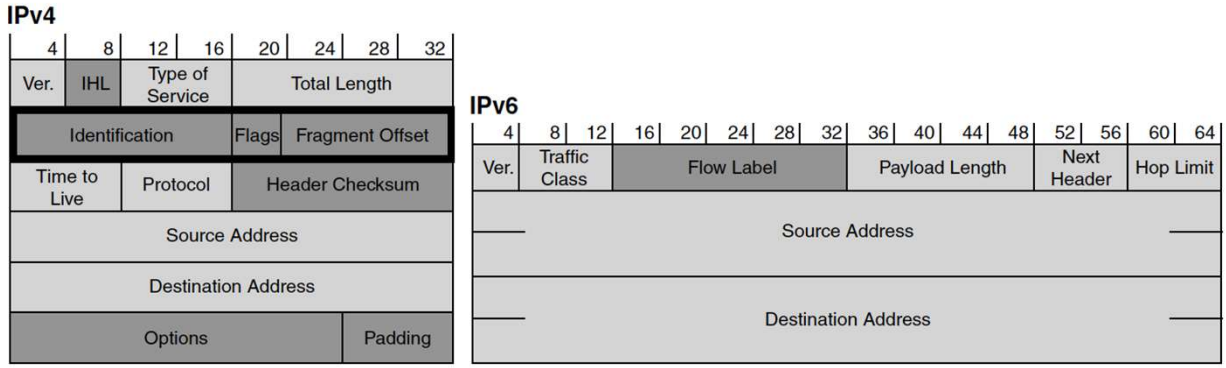

Figure 3-10 *Fragmentation Fields in IPv4 Header That Do Not Exist in IPv6 Header*

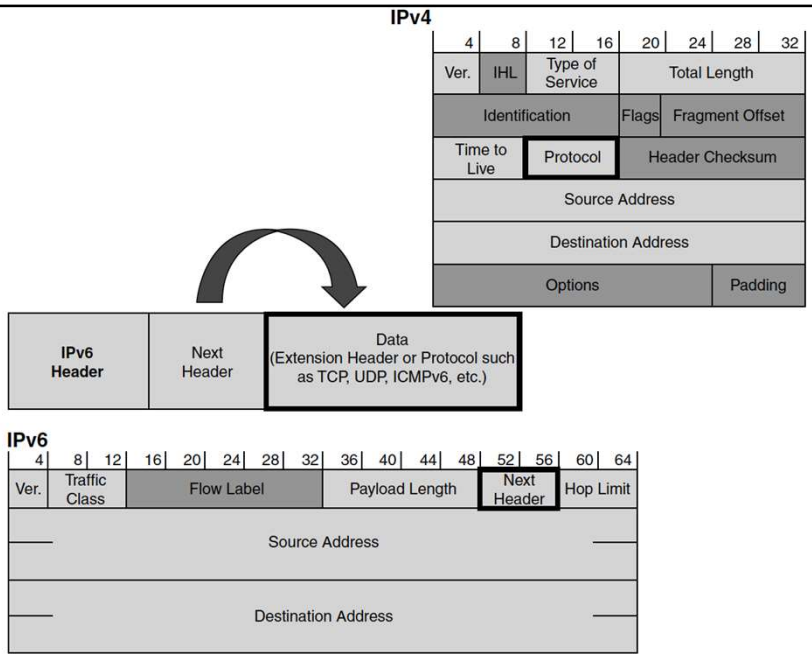

Figure 3-11 *IPv4 Protocol Field and IPv6 Next Header Field*

Table 3-1 *Significant IPv6 Next Header Field Values*

Next Header Field Value (Decimal)	Next Header Field Value (Hexadecimal)	Description
0	0	Hop-by-hop options extension header for IPv6
1	1	Internet Control Message Protocol version 4 (ICMPv4)
2	2	Internet Group Management Protocol version 4 (IGMPv4)
4	4	IPv4 encapsulation
5	5	Internet Stream Protocol (ST)
6	6	Transmission Control Protocol (TCP)
8	8	Exterior Gateway Protocol (EGP)
17	11	User Datagram Protocol (UDP)
41	29	IPv6 encapsulation
43	2B	Routing extension header for IPv6
44	2C	Fragment header for IPv6
46	2E	Resource Reservation Protocol (RSVP)
47	2F	Generic Routing Encapsulation (GRE)
50	32	Encapsulating Security Payload (ESP)
51	33	Authentication Header (AH)
58	3A	Internet Control Message Protocol version 6 (ICMPv6)
59	3B	No Next Header for IPv6
60	3C	Destinations options extension header for IPv6
88	58	Enhanced Interior Gateway Routing Protocol (EIGRP)
89	59	Open Shortest Path First (OSPF)

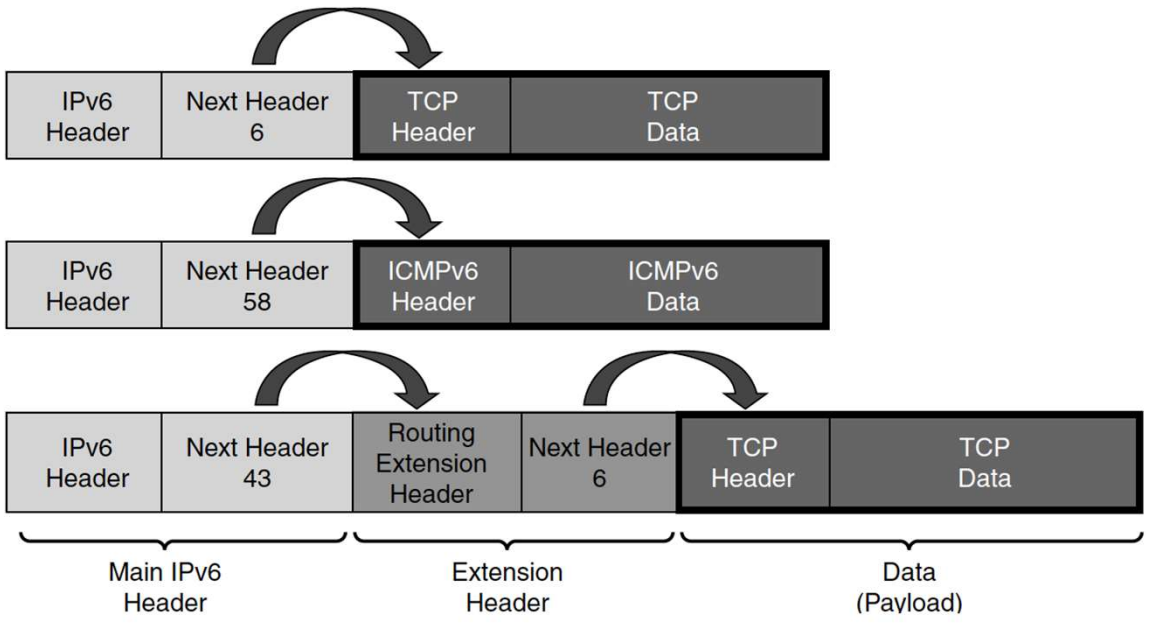

Figure 3-12 *IPv6 Next Header Examples*

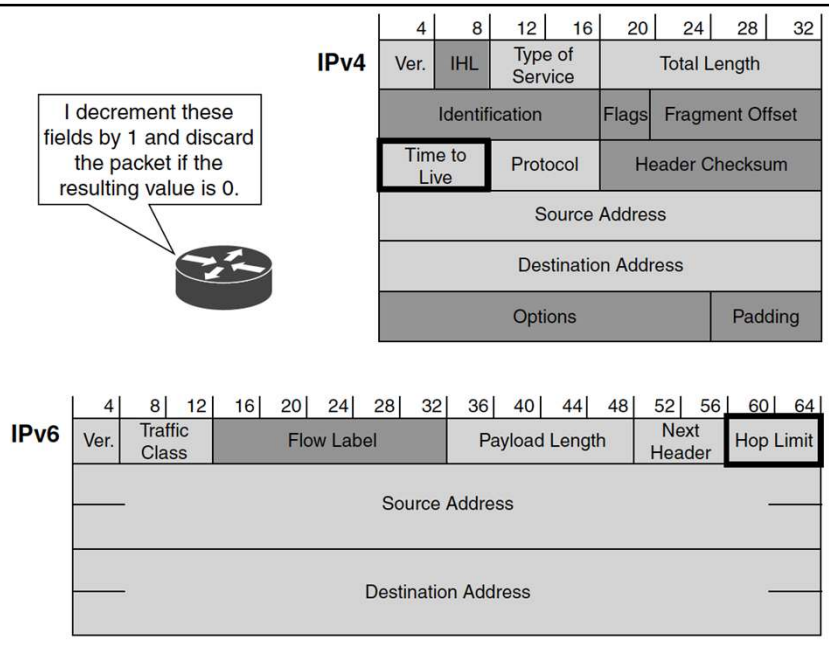

Figure 3-13 *IPv4 TTL Field and IPv6 Hop Limit Field*

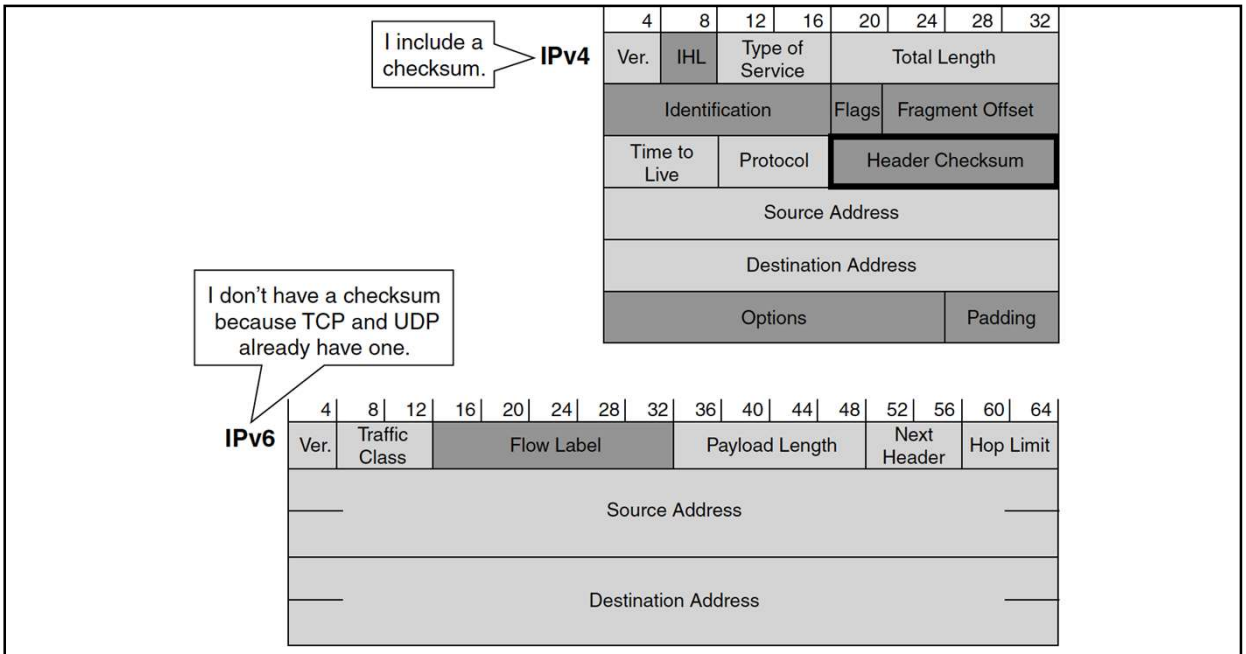

Figure 3-14 *IPv4 Checksum Field*

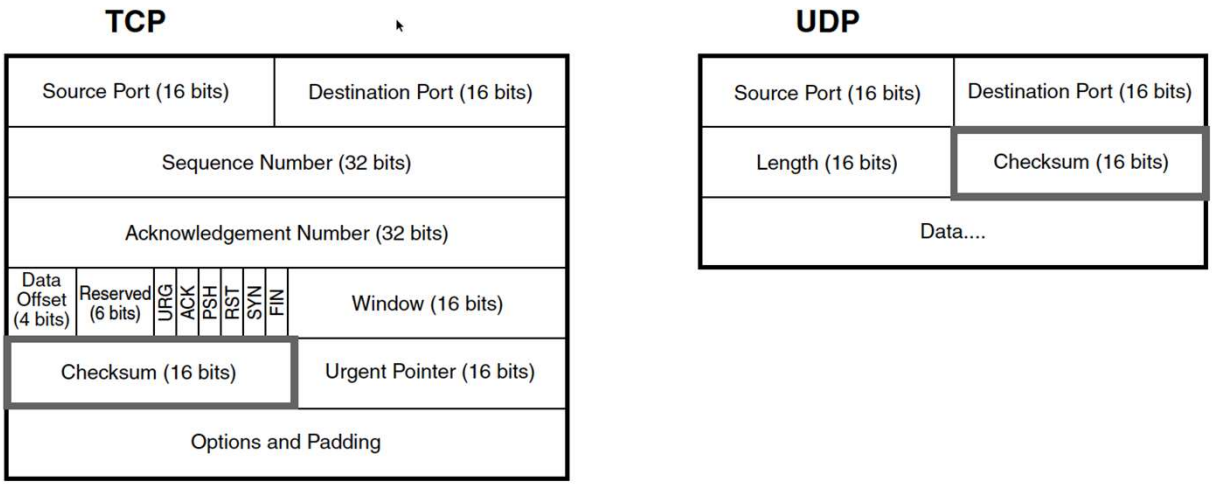

Figure 3-15 *TCP and UDP*

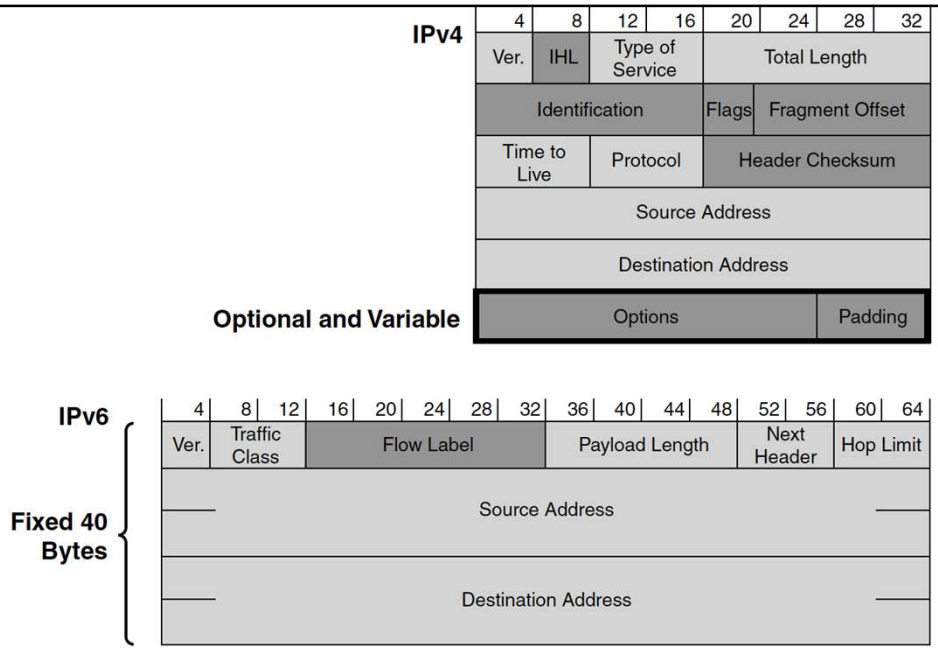

Figure 3-16 *IPv4 Options and Padding Fields and Fixed IPv6 Header*

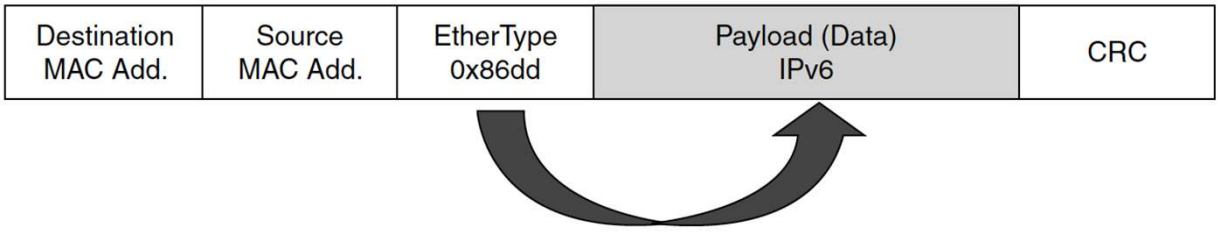

Figure 3-17 *IPv6 Packet Encapsulated in an Ethernet II Frame*

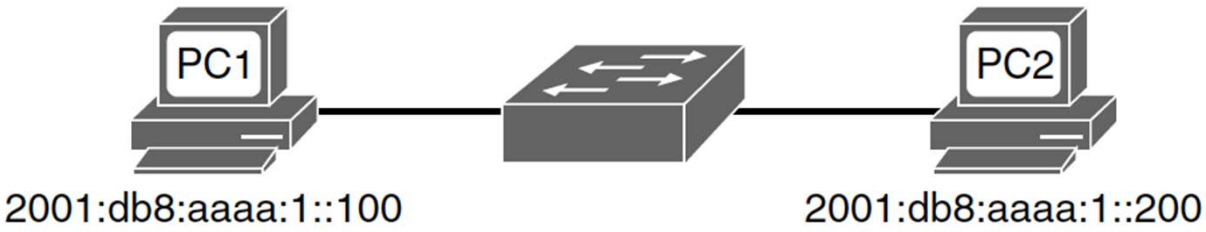

Figure 3-18 *PC1 Pinging an IPv6 Address on PC2*

Example 3-1 *Ping from PC1 to PC2*

```
PC1> ping 2001:db8:aaaa:1::200

Pinging 2001:db8:aaaa:1::200 from 2001:db8:aaaa:1::100 with 32 bytes of data:
Reply from 2001:db8:aaaa:1::200: time<1ms
Reply from 2001:db8:aaaa:1::200: time<1ms
Reply from 2001:db8:aaaa:1::200: time<1ms
Reply from 2001:db8:aaaa:1::200: time<1ms

Ping statistics for 2001:db8:aaaa:1::200:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

PC1>
```

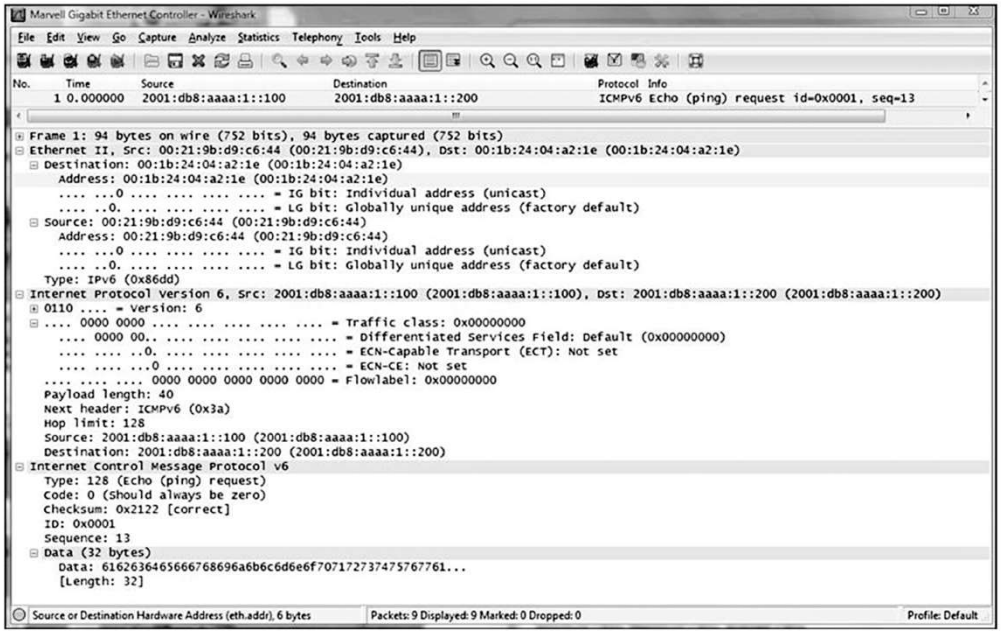

Figure 3-19 *Wireshark Capture of an IPv6 Packet*

Table 3-2 *Analysis of an Ethernet Frame Carrying an IPv6 Packet*

	Field Name	Size (Bits)	Value—Description
Ethernet II Header (16 Bytes)	Destination Address	48	**00:1b:24:04:a2:1e**—The destination MAC address in hexadecimal.
	Source Address	48	**00:21:9b:d9:c6:44**—The source MAC address in hexadecimal.
	Type	16	**0x86dd**—Indicates the protocol of the data (payload), which in this case is an IPv6 packet.
IPv6 Header (40 Bytes)	Version	4	**6**—Indicates IP version 6.
	Traffic Class	8	**0**—Default is 0.
	Flow Label	20	**0**—Default is 0.
	Payload Length	16	**40 bytes**—Indicates the size of the data, which in this case is an ICMPv6 message. Notice that the ICMPv6 message has a length of 40 bytes.
	Next Header	8	**58**—Identifies the following header as an ICMPv6 header. See Table 3-1 for a partial list of IPv6 Next Header values.

	Field Name	Size (Bits)	Value—Description
	Hop Limit	8	**128**—Indicates the maximum number of routers that this packet can traverse before being discarded.
	Source Address	128	**2001:0db8:aaaa:1::100**—The source IPv6 address in hexadecimal.
	Destination Address	128	**2001:0db8:aaaa:1::200**—The destination IPv6 address in hexadecimal.
ICMPv6 Header (40 Bytes)	Type	8	**128**—Identifies this as an ICMPv6 Echo Request message.
	Code	8	**0**—Not used; default is 0.
	Checksum	16	**0x2122**—16-bit checksum that is used to verify the integrity of the ICMPv6 header.
	ID	16	**0x0001**—Used to help match ICMPv6 Echo Request and Echo Reply messages.
	Sequence	16	**13**—Used to help match ICMPv6 Echo Request and Echo Reply messages.
	Data	256	Optional data of variable length depending upon the type of ICMPv6 message.

Table 3-3 *IPv6 Extension Headers*

Next Header Value (Decimal)	Extension Header Name	Extension Header Length (Bytes)	Variable-Length Options (TLV) Used?	Extension Header Description
0	Hop-by-Hop Options	Variable	Yes	Used to carry optional information, which must be examined by every router along the path of the packet.
43	Routing	Variable	No	Allows the source of the packet to specify the path to the destination.
44	Fragment	8	No	Used to fragment IPv6 packets.
50	Encapsulating Security Payload (ESP)	Variable	No	Used to provide authentication, integrity, and encryption.
51	Authentication Header (AH)	Variable	No	Used to provide authentication and integrity.
60	Destination Options	Variable	Yes	Used to carry optional information that only needs to be examined by a packet's destination node(s).

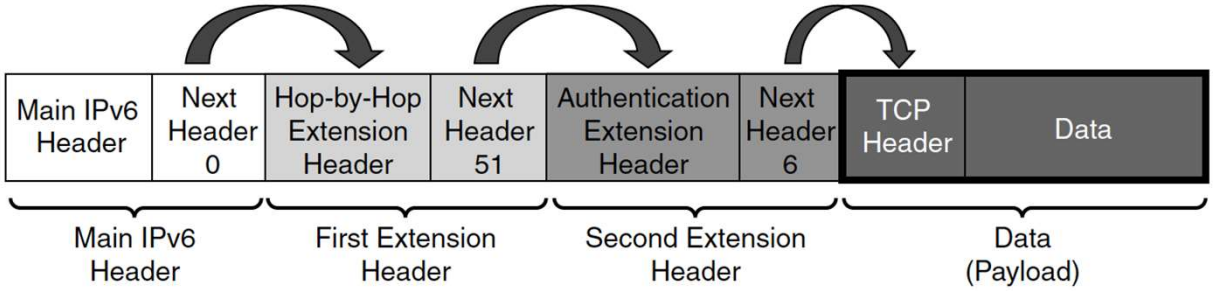

Figure 3-20 *Use of the Next Header Field in Extension Headers*

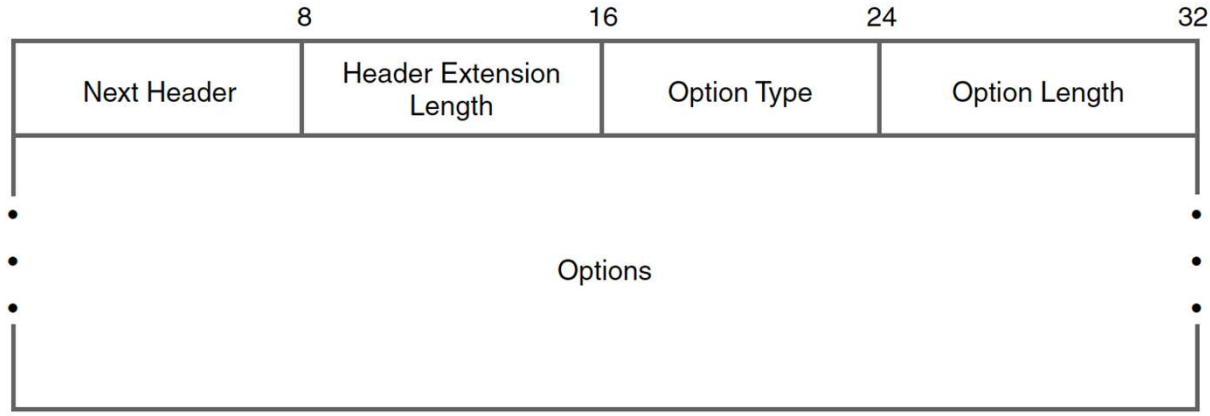

Figure 3-21 *Extension Header Options*

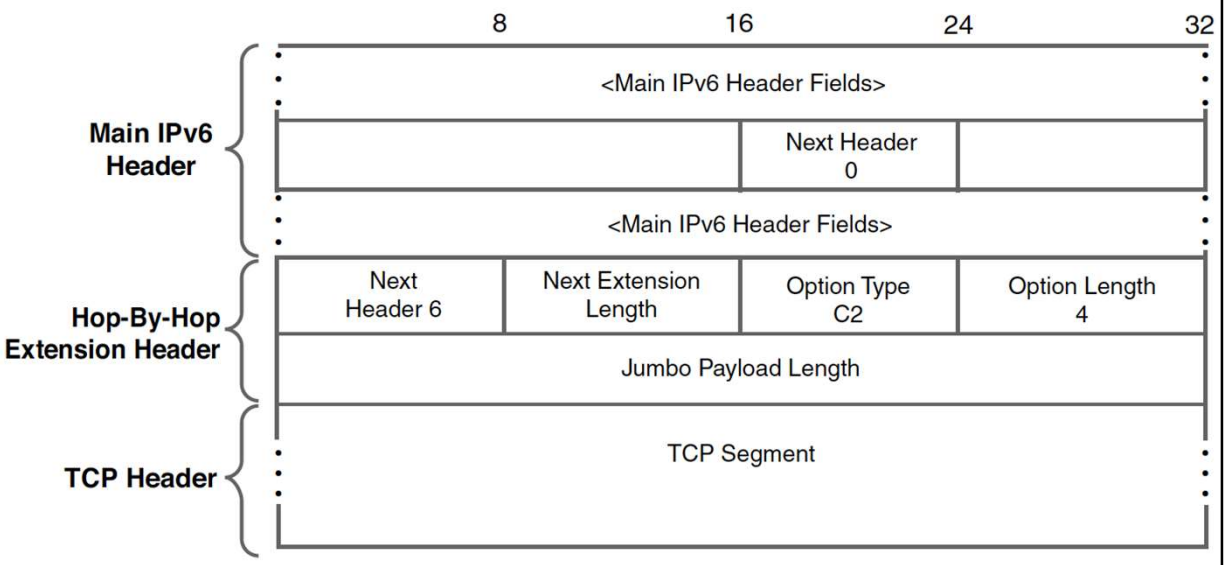

Figure 3-22 *Hop-by-Hop Extension Header with a Jumbo Payload Option*

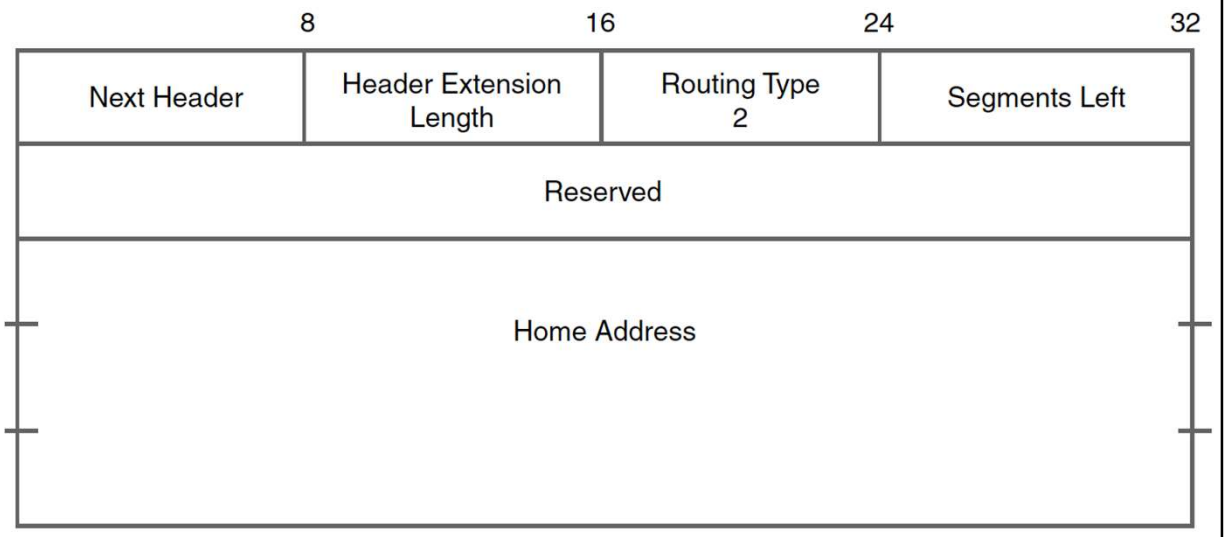

Figure 3-23 *Type 2 Routing Header*

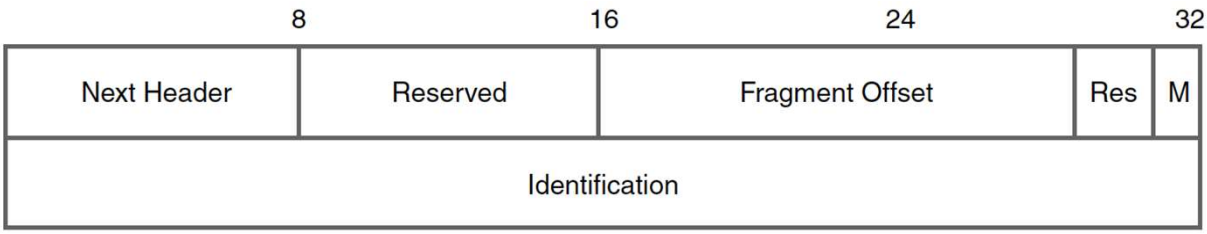

Figure 3-24 *Fragment Header*

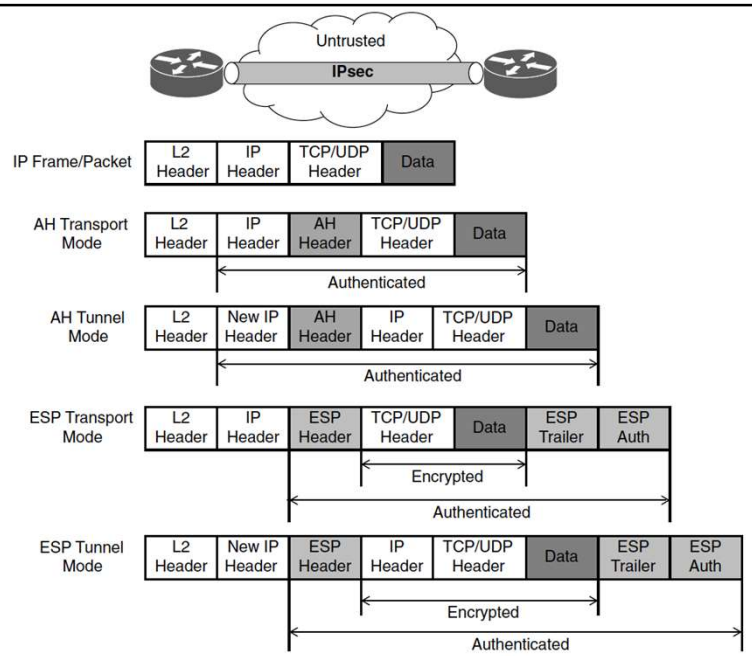

Figure 3-25 *Transport and Tunnel Modes*

Conclusion

Comparing IPv4 and IPv6

"It is exactly the same, only completely different."

-- Anonymous