Computer Network

Lecture-33

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IPv6

IPv6:

IPv4 has **some deficiencies** that make it unsuitable for the fast-growing Internet.

- Despite all short-term solutions, such as subnetting, classless addressing, and NAT, address depletion is still a long-term problem in the Internet.
- The Internet must accommodate real-time audio and video transmission. This type of transmission requires minimum delay strategies and reservation of resources not provided in the IPv4 design.
- The Internet must accommodate encryption and authentication of data for some applications. No encryption or authentication is provided by IPv4.

To overcome these deficiencies, IPv6 (Internetworking Protocol, version 6), also known as IPng (Internetworking Protocol, next generation), was proposed.

IPv6

Advantages of IPv6 over IPv4

- **Larger address space:** An IPv6 address is 128 bits long. Compared with the 32-bit address of IPv4, this is a huge (2^{96}) increase in the address space.
- **Better header format:** IPv6 uses a new header format in which options are separated from the base header and inserted, when needed, between the base header and the upper-layer data. This simplifies and speeds up the routing process because most of the options do not need to be checked by routers.
- **New options:** IPv6 has new options to allow for additional functionalities.
- **Allowance for extension:** IPv6 is designed to allow the extension of the protocol if required by new technologies or applications.

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- Support for resource allocation. In IPv6, the type-of-service field has been removed, but a mechanism (called Flow label) has been added to enable the source to request special handling of the packet. This mechanism can be used to support traffic such as real-time audio and video.
- Support for more security. The encryption and authentication options in IPv6 provide confidentiality and integrity of the packet.

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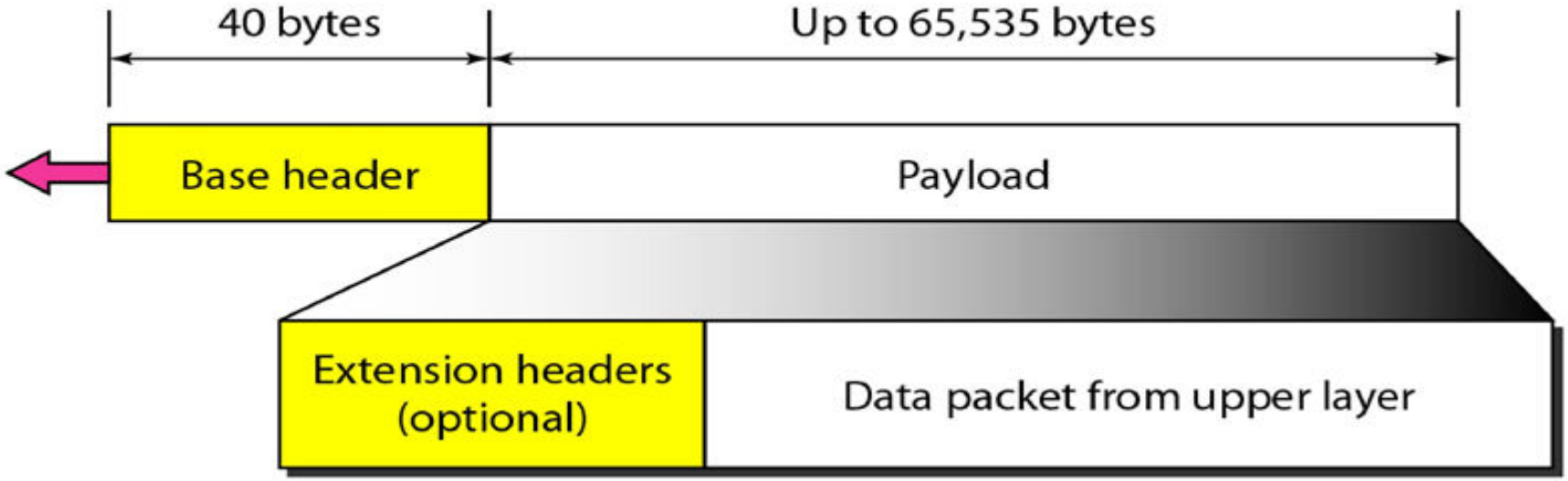
Packet Format

Each packet is composed of a mandatory base header followed by the payload. The payload consists of two parts: optional extension headers and data from an upper layer. The base header occupies 40 bytes, whereas the extension headers and data from the upper layer contain up to 65,535 bytes of information. It is shown in the following figure:-



IPv6 datagram header and payload

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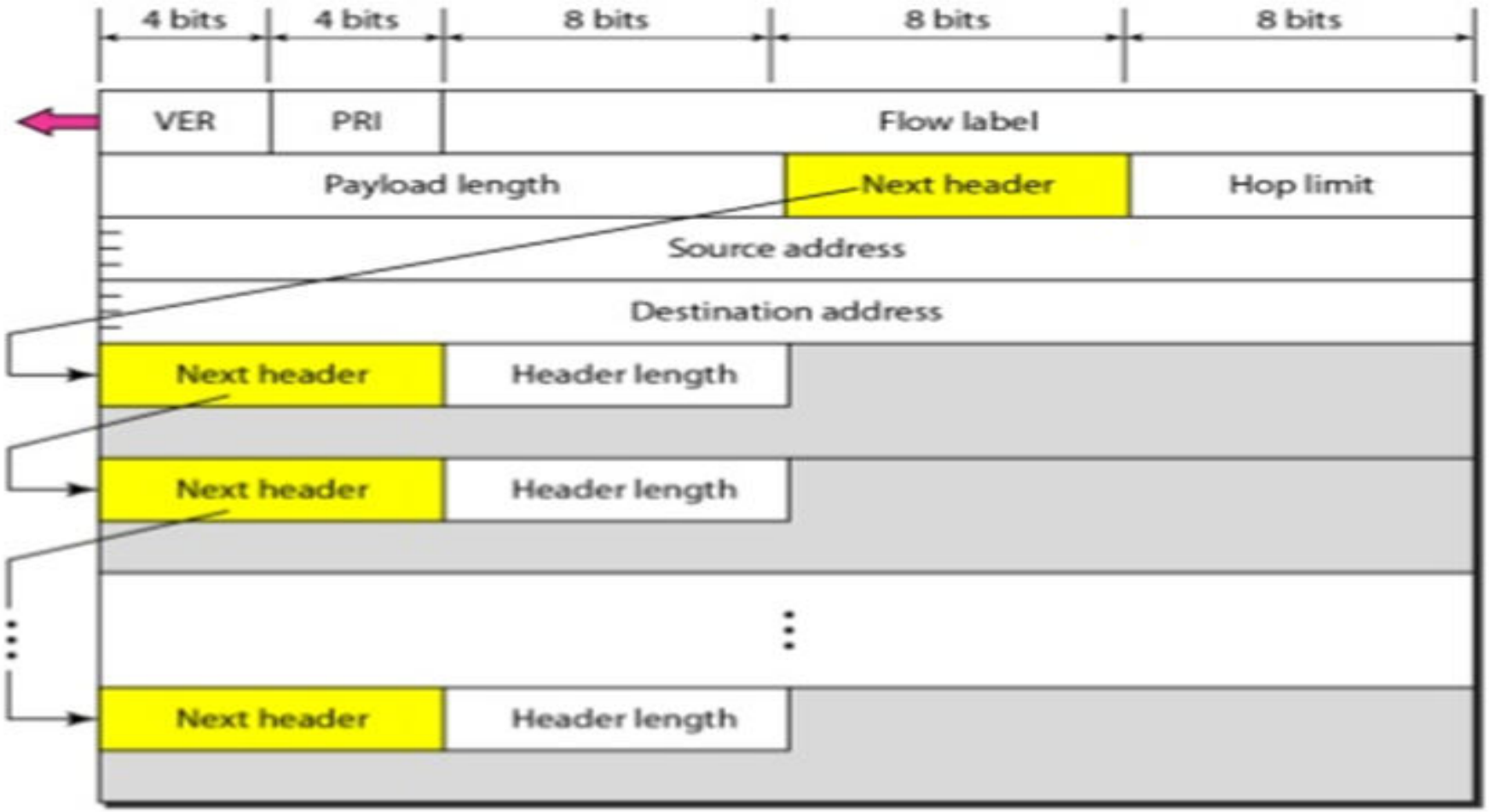
Format of an IPv6 datagram



IPv6

Base Header

The fields in the base header are as the following:-

Version: This 4-bit field defines the version number of the IP. For IPv6, the value is 6.

Priority: The 4-bit priority field defines the priority of the packet with respect to traffic congestion.

Flow label: The flow label is a 3-byte (24-bit) field that is designed to provide special handling for a particular flow of data.

Payload length: The 2-byte payload length field defines the length of the IP datagram excluding the base header.

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Next header: The next header is an 8-bit field defining the header that follows the base header in the datagram. The next header is either one of the optional extension headers used by IP or the header of an encapsulated packet such as UDP or TCP. Each extension header also contains this field. Note that this field in version 4 is called the protocol.

Hop limit: This 8-bit hop limit field serves the same purpose as the TTL field in IPv4.

Source address: The source address field is a 16-byte (128-bit) Internet address that identifies the original source of the datagram.

Destination address: The destination address field is a 16-byte (128-bit) Internet address that usually identifies the final destination of the datagram.

Exercise

1. An IPv4 datagram has arrived with the following information in the header (in hexadecimal):

0x45 00 00 54 00 03 58 50 20 06 00 00 7C 4E 03 02 B4 0E 0F 02

a. Is the packet corrupted?

b. Are there any options?

c. Is the packet fragmented?

d. What is the size of the data?

e. How many more routers can the packet travel to?

f. What is the identification number of the packet?

g. What is the type of service?

2. In an IPv4 datagram, the M bit is 0, the value of HLEN is 5, the value of total length is 200, and the offset value is 200. What is the number of the first byte and number of the last byte in this datagram? Is this the last fragment, the first fragment, or a middle fragment?