

Network Layer Protocols

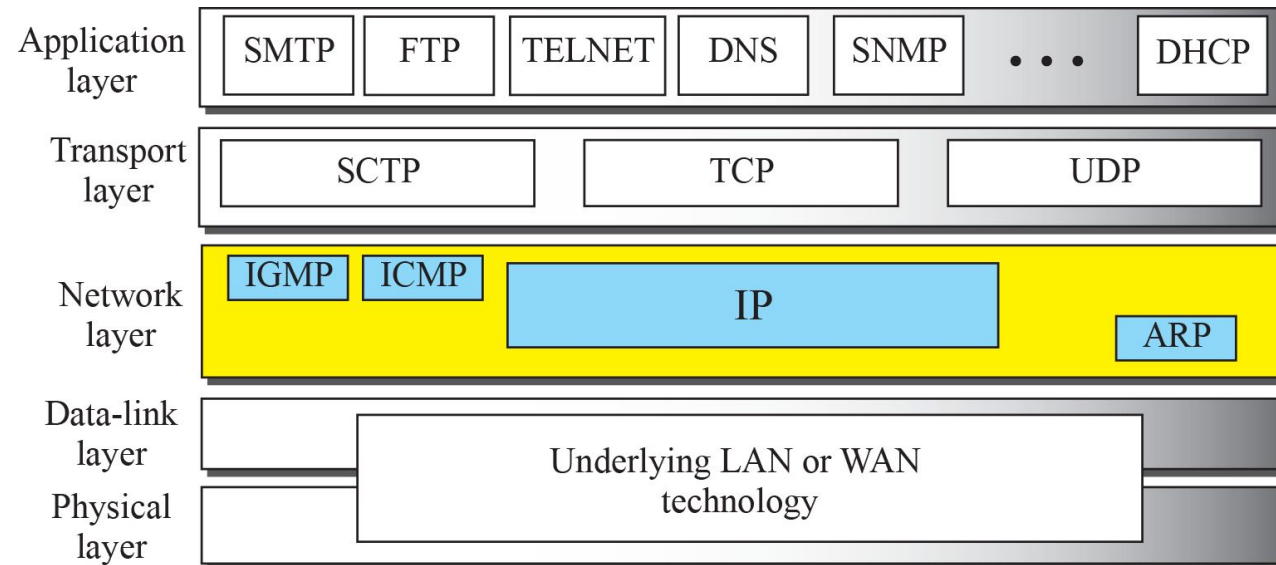
Topics of Discussion

In this session we will learn the following

- ✓ Network Layer Protocols
- ✓ IPv4
- ✓ ICMP
- ✓ IPv6

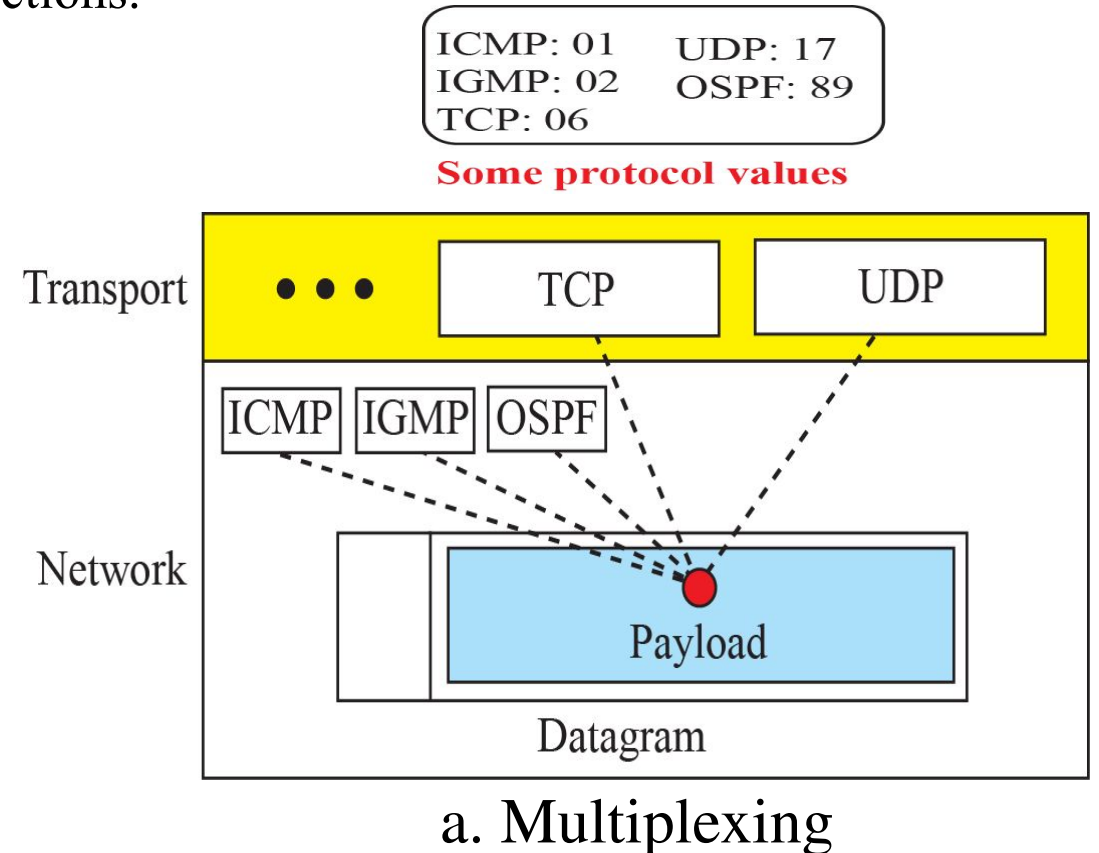
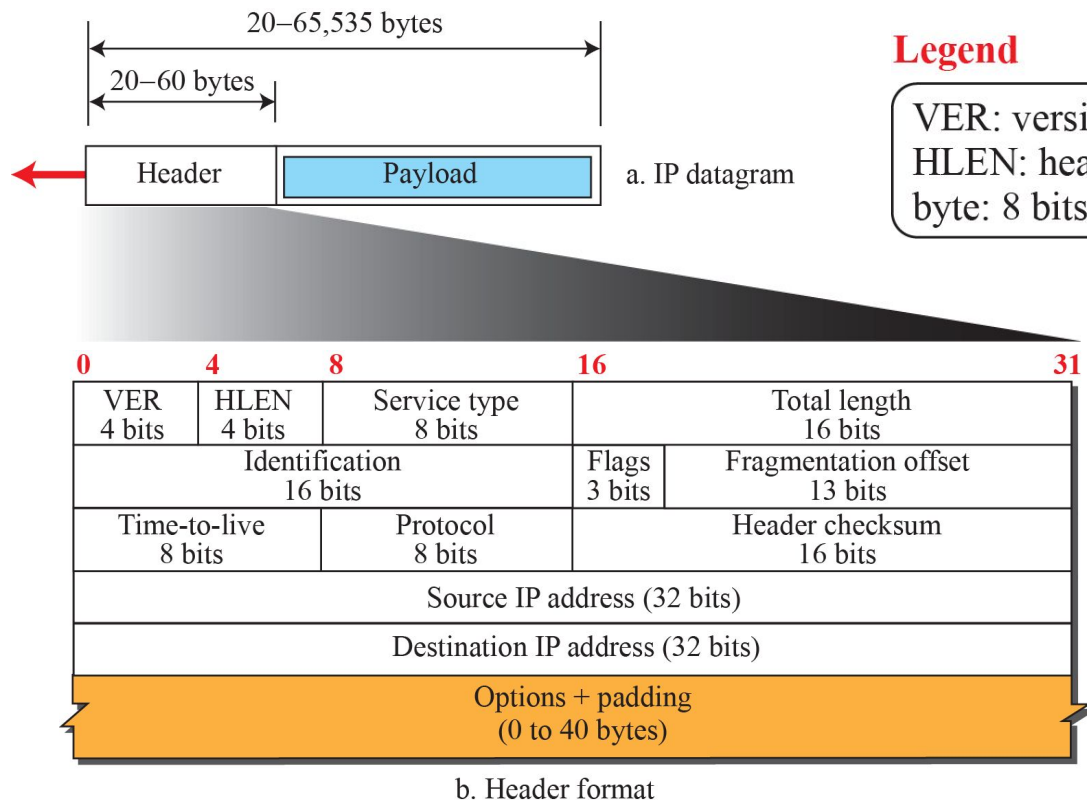
Network Layer Protocols

- The network layer in version 4 can be thought of as one main protocol.
- IPv4, is responsible for packetizing, forwarding, and delivery of a packet.
- The ICMP(Internet Control Message Protocol) v4 helps IPv4 to handle some errors that may occur in delivery.
- The IGMP (Internet Group Management Protocol) is used to help IPv4 in multicasting.
- ARP is used in address mapping.



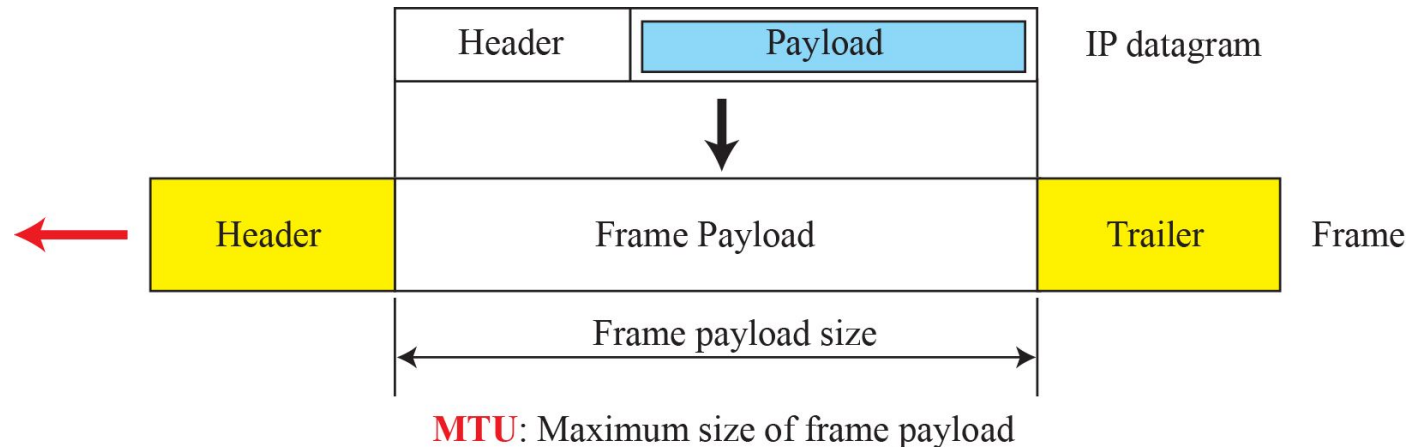
IPv4 protocol

- Packets used by the IP are called datagrams. Figure below shows the IPv4 datagram format.
- A datagram is a variable-length packet consisting of two parts: **header and payload (data)**.
- The header is 20 to 60 bytes in length and contains information essential to routing and delivery.
- It is customary in TCP/IP to show the header in 4-byte sections.



Fragmentation Offset

- A datagram can travel through different networks.
- Each router decapsulates the IP datagram from the frame it receives, processes it, and then encapsulates it in another frame.
- The format and size of the received frame depend on the protocol used by the physical network through which the frame has just traveled.
- The format and size of the sent frame depend on the protocol used by the physical network through which the frame is going to travel.
- For example, if a router connects a LAN to a WAN, it receives a frame in the LAN format and sends a frame in the WAN format.



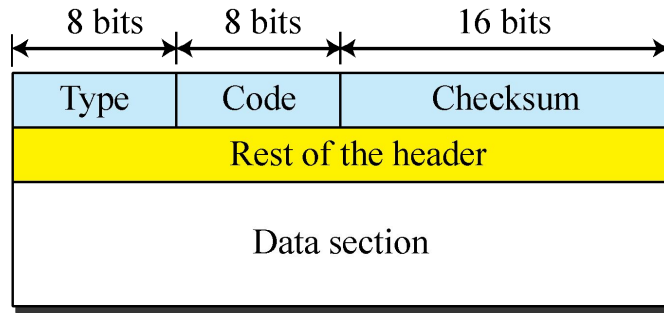
Options in the frame format

- The header of the IPv4 datagram is made of two parts: **a fixed part and a variable part.**
- The fixed part is 20 bytes long and was discussed in the previous section.
- The variable part comprises the options that can be a maximum of 40 bytes (in multiples of 4-bytes) to preserve the boundary of the header.

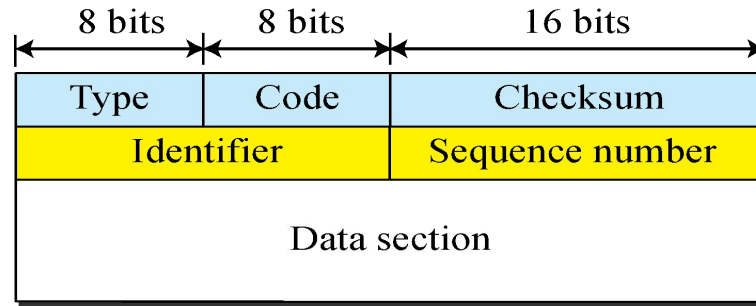
ICMPv4

- The IPv4 has no error-reporting or error-correcting mechanism.
- The IP protocol also lacks a mechanism for host and management queries.
- **The Internet Control Message Protocol version 4 (ICMPv4)** has been designed to compensate for the above two deficiencies.
- **ICMP messages** are divided into two broad categories: **error-reporting messages and query messages**.
- The error-reporting messages report problems that a router or a host (destination) may encounter when it processes an IP packet.
- The query messages, which occur in pairs, help a host or a network manager get specific information from a router or another host.
- For example, nodes can discover their neighbors. Also, hosts can discover and learn about routers on their network and routers can help a node redirect its messages.

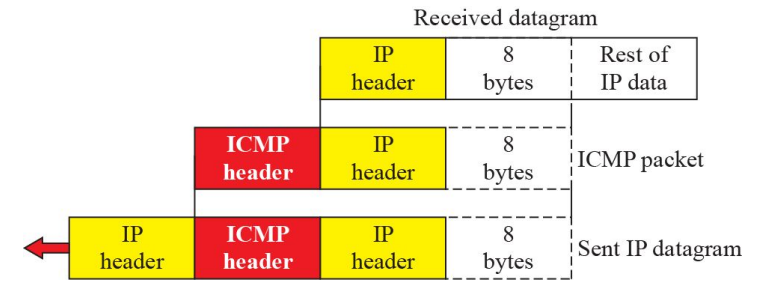
ICMP Message Formats



Error-reporting messages



Query messages



Contents of data field for the error messages

Type and code values

Error-reporting messages

- 03: Destination unreachable (codes 0 to 15)
- 04: Source quench (only code 0)
- 05: Redirection (codes 0 to 3)
- 11: Time exceeded (codes 0 and 1)
- 12: Parameter problem (codes 0 and 1)

Query messages

- 08 and 00: Echo request and reply (only code 0)
- 13 and 14: Timestamp request and reply (only code 0)

Note: See the book website for more explanation about the code values.

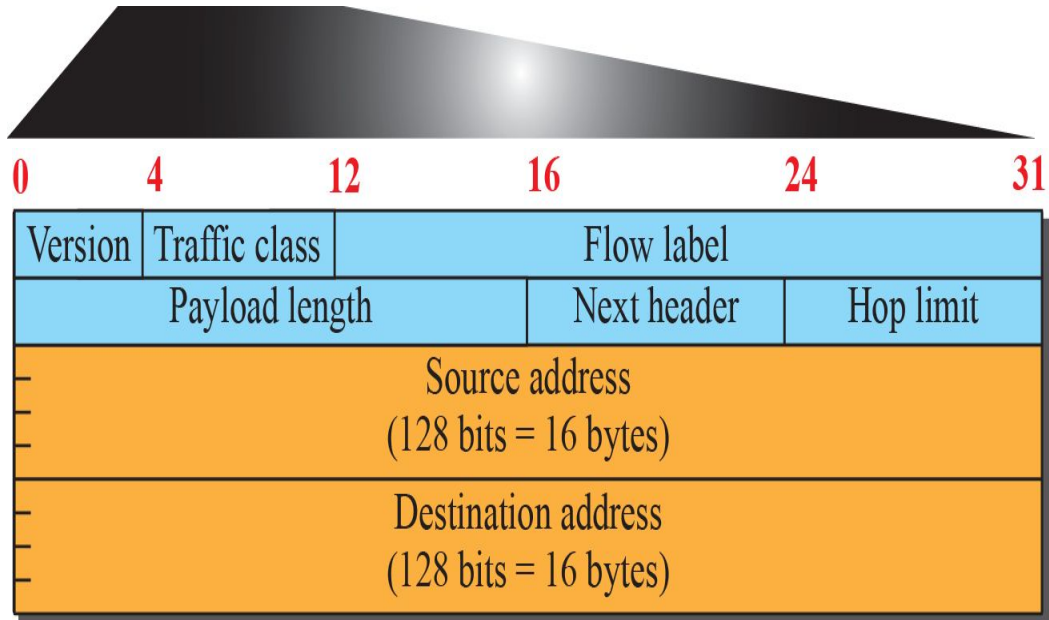
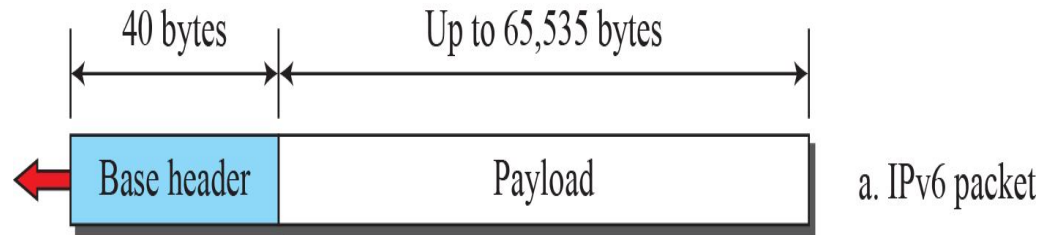
IPv6 Protocol

- The change of the IPv6 address size requires the change in the IPv4 packet format.
- The designer of IPv6 decided to implement remedies for other shortcomings now that a change is inevitable.
- The following shows other changes implemented in the protocol in addition to changing address size and format.

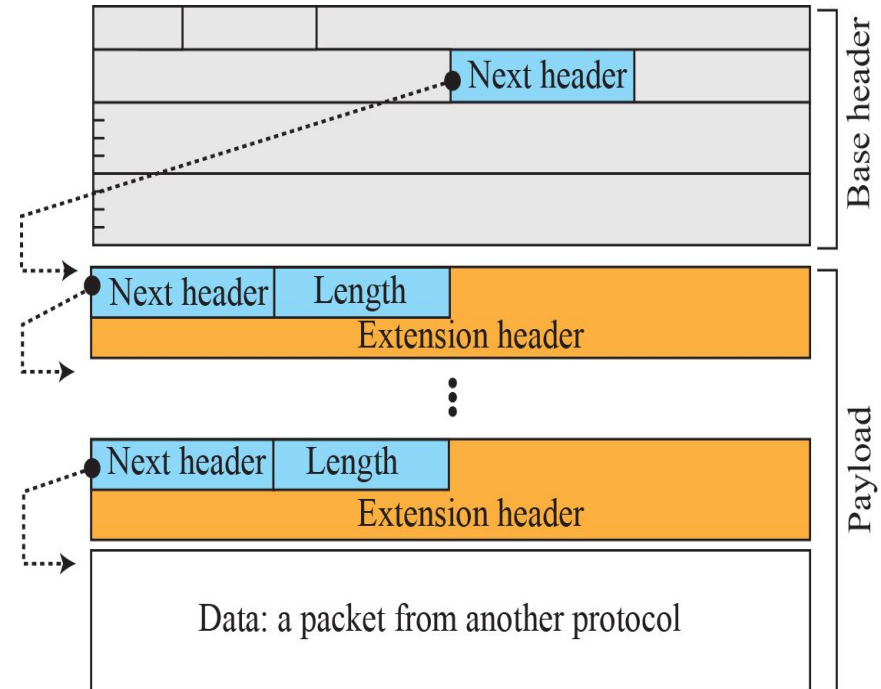
Packet Format:

- The IPv6 packet is shown in Figure below.
- Each packet is composed of a base header followed by the payload.
- The base header occupies 40 bytes, whereas payload can be up to 65,535 bytes of information.

IPv6 Frame Format



b. Base header

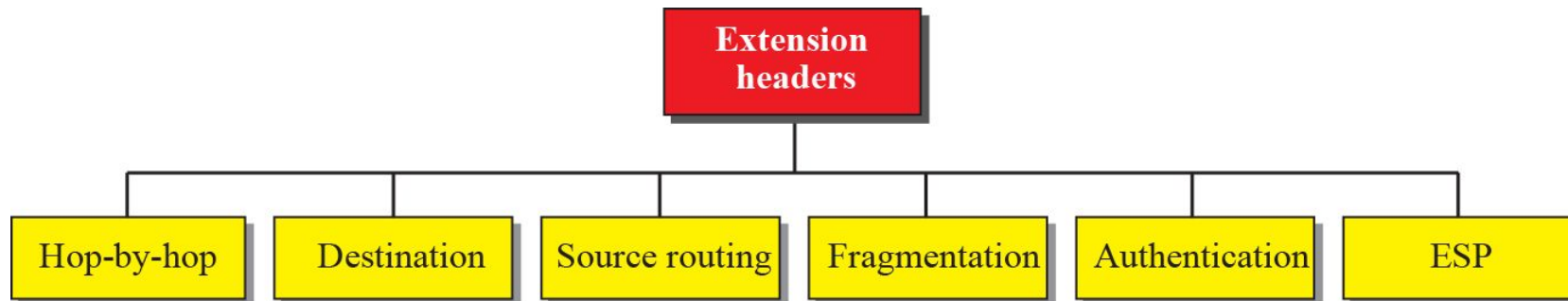


Some next-header codes

- 00: Hop-by-hop option
- 02: ICMPv6
- 06: TCP
- 17: UDP
- 43: Source-routing option
- 44: Fragmentation option
- 50: Encrypted security payload
- 51: Authentication header
- 59: Null (no next header)
- 60: Destination option

Extension Header

- An IPv6 packet is made of a base header and some extension headers. The length of the base header is fixed at 40 bytes.
- However, to give more functionality to the IP datagram, the base header can be followed by up to six extension headers.
- Many of these headers are options in IPv4.
- Six types of extension headers have been defined. These are hop-by-hop option, source routing, fragmentation, authentication, encrypted security payload, and destination option.



Summary

In this section we have discussed the following:

- ✓ IPv4
- ✓ ICMP
- ✓ IPv6

Thank
you!