Networking Essentials
ITC 2243

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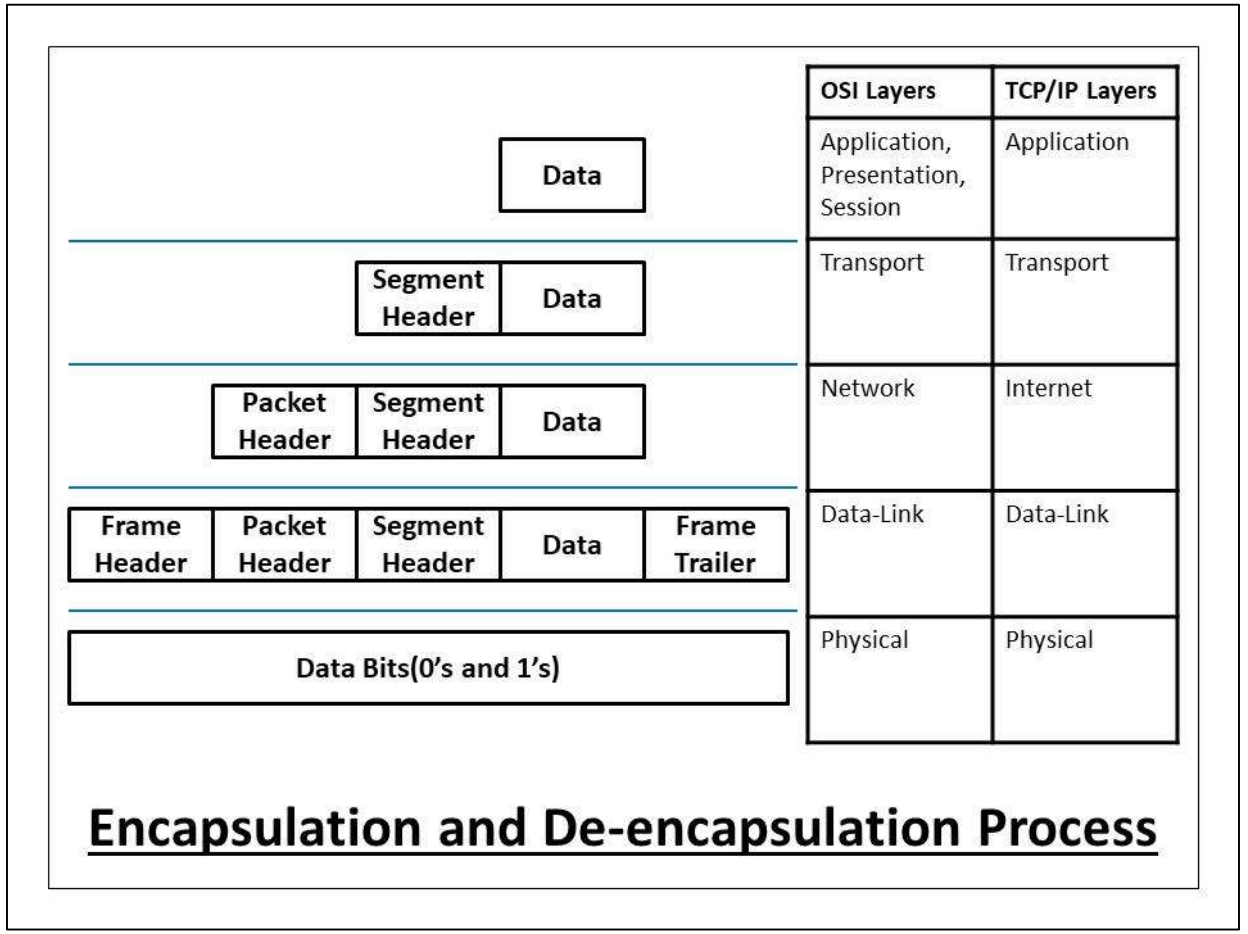
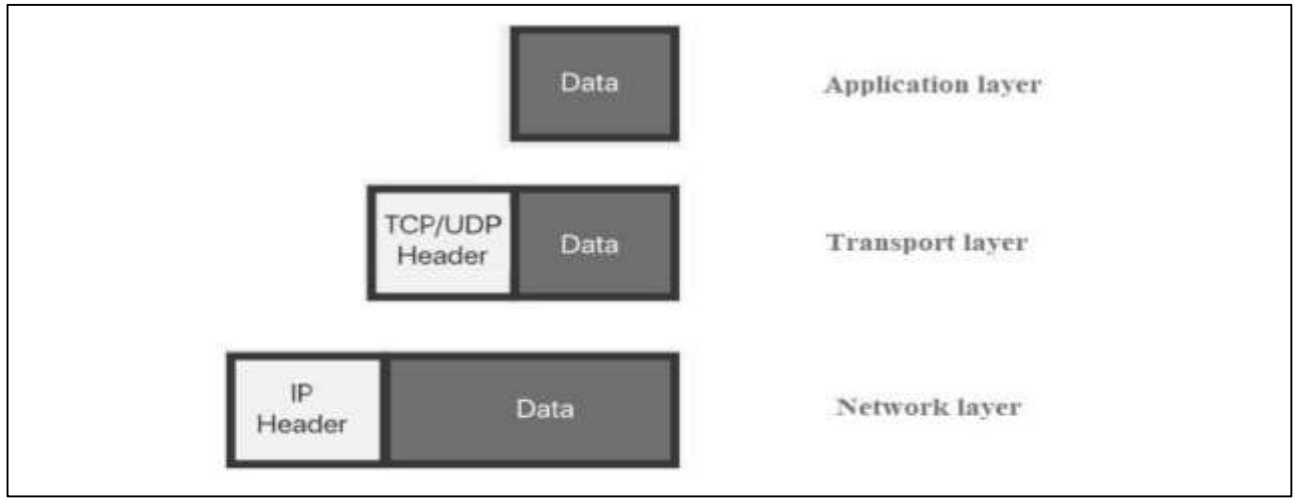
Transport Layer and Network Layer Headers



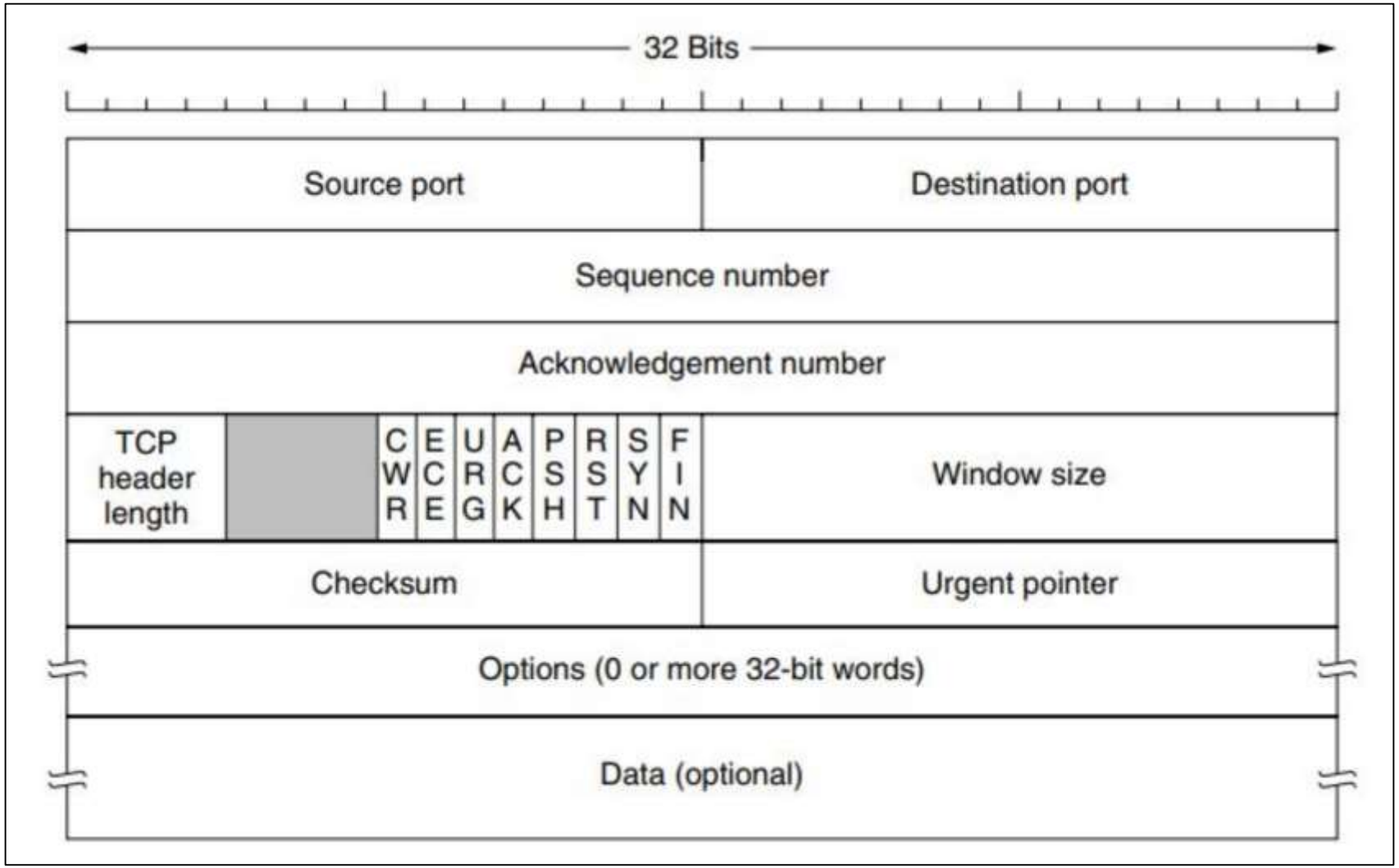
Header tags

- When 2 devices wants to communicate with each other over a network, it does so by constructing packets of data and then sending them to each other.

- A data packet is basically a structured data, where the actual payload data is nested inside header tags. The header tag's contains information to help routing the data packets.



TCP Header


32 Bits
Source port
Destination port
Sequence number
Acknowledgement number
TCP header length
CWR
ECE
URG
ACK
PSH
RST
SYN
FIN
Window size
Checksum
Urgent pointer
Options (0 or more 32-bit words)
Data (optional)

TCP Header

- **SrcPort** and **DstPort** fields identify the source and destination ports, respectively.

- **Sequence number** identifies the byte in the stream of data from the sending TCP to the receiving TCP that the first byte of data in this segment represents. (TCP assigns a unique sequence number to each byte of data)

- **Acknowledgement number** field contains the next sequence number that the sender of the acknowledgement expects to receive. This is therefore the sequence number plus 1 of the last successfully received byte of data.

- **Window size** It advertises how much data (in bytes) the sender can send without acknowledgement.

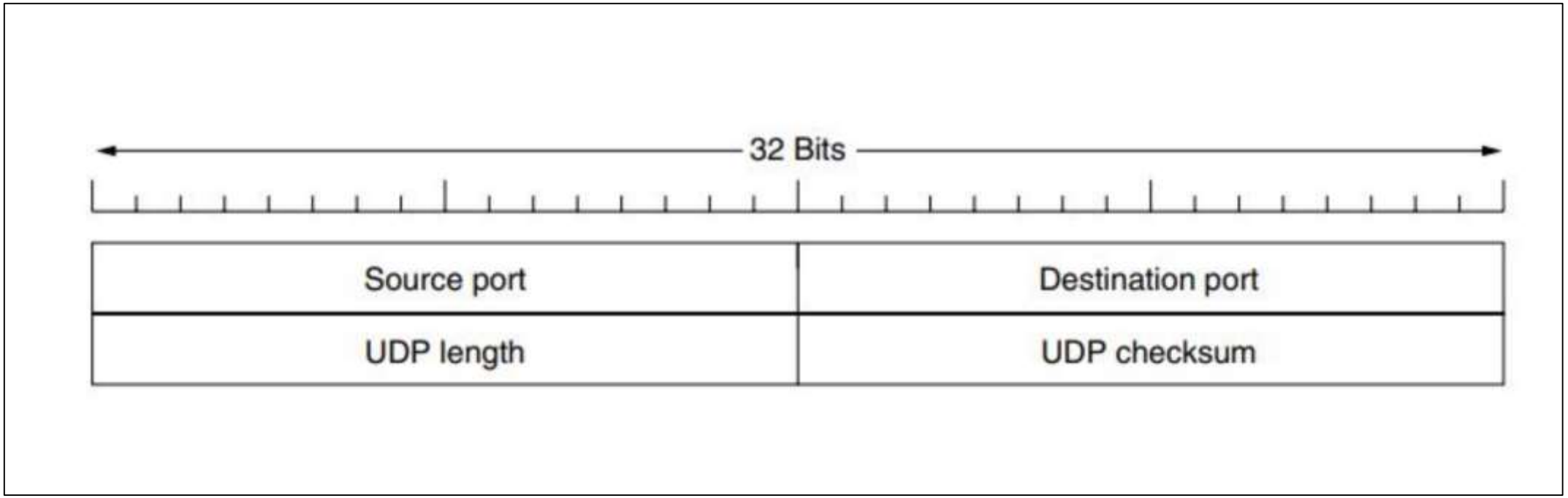
- **Header length** gives the length of the header in 32-bit words. This is required because the length of the options field is variable.

- **Flags –** used to control or identify bits.

- **Checksum** field is used for error-checking of the TCP header, the payload and an IP pseudo-header.

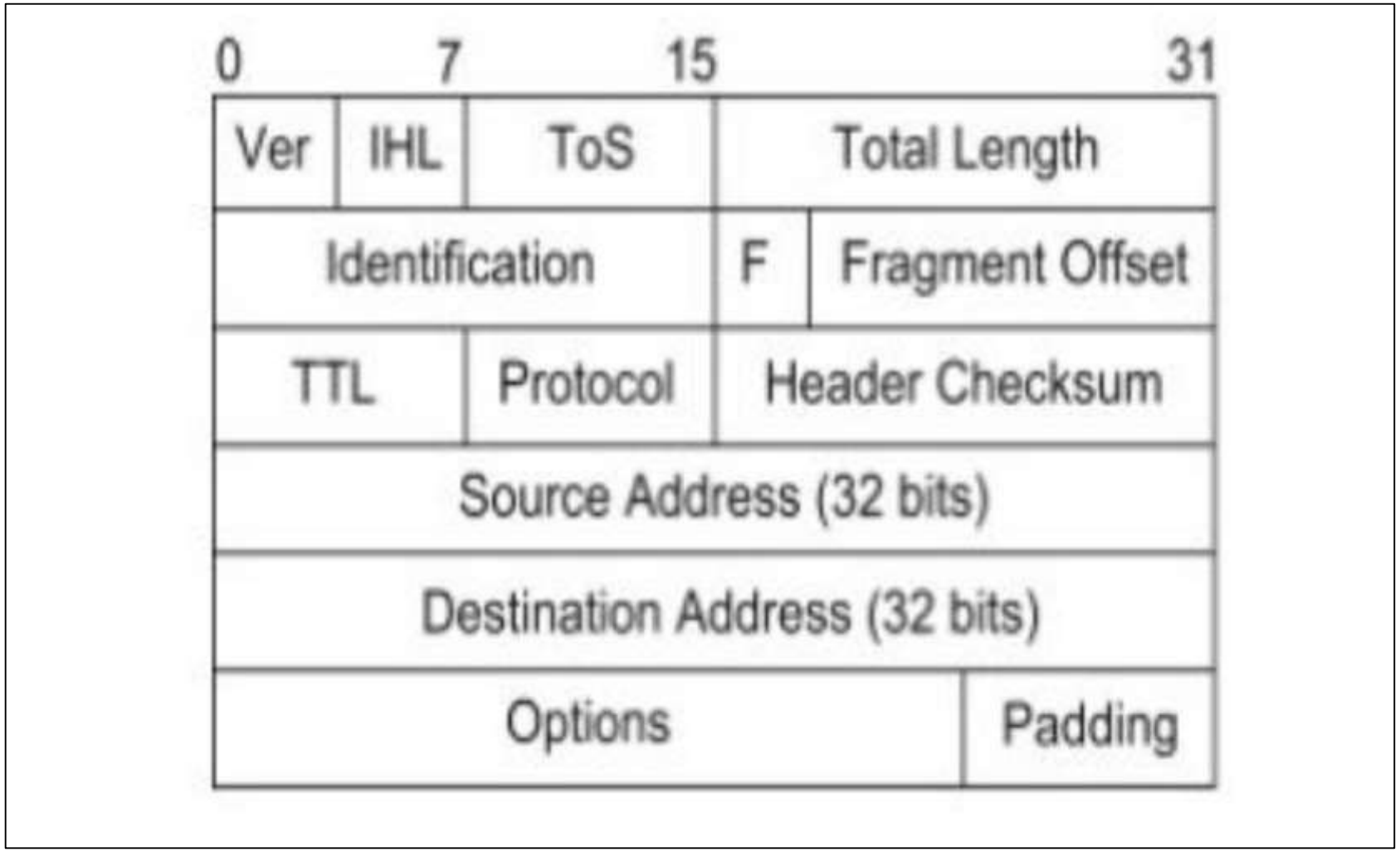
- **Urgent pointer** used when the URG bit has been set, the urgent pointer is used to indicate where the urgent data ends.

UDP Header



- **SrcPort and DstPort -** fields identify the source and destination ports, respectively.
- **Length -** This field specifies the length in bytes of the UDP header and UDP data.
- **Checksum -** The checksum field may be used for error-checking of the header and data.

IPv4 Header


0
7
15
31
Ver
IHL
ToS
Total Length
Identification
F
Fragment Offset
TTL
Protocol
Header Checksum
Source Address (32 bits)
Destination Address (32 bits)
Options
Padding

IPv4 Header

- **Version** – the version of the IP protocol. For IPv4, this field has a value of 4.
- **Header length** – The IPv4 header is variable in size due to the optional field. Max is 60 bytes.
- **Priority and Type of Service** – specifies how the datagram should be handled.
- **Total length –** The length of the entire packet (header + data). The minimum length is 20 bytes, and the maximum is 65,535 bytes.
- **Flags –** used to control or identify fragments.
- **Identification –** used to differentiate fragmented packets from different datagrams.
- **Fragmented offset –** used for fragmentation and reassembly if the packet is too large to put in a frame.
- **Time to live –** limits a datagram's lifetime. If the packet doesn't get to its destination before the TTL expires, it is discarded.
- **Protocol –** defines the protocol used in the data portion of the IP datagram. Ex, TCP or UDP
- **Header checksum –** used for error-checking of the header.
- **Source IP address –** the IP address of the host that sent the packet.
- **Destination IP address –** the IP address of the host that should receive the packet.
- **Options –** used for network testing, debugging, security, and more. This field is usually empty.

IPv6 Header


0
7
15
31
Ver
Traffic Class
Flow Label
Payload Length
Next Header
Hop Limit
Source Address
128 bits
Destination Address
128 bits

IPv6 Header

- **Version:** This 4-bit field identifies the IP version number.
- **Traffic Class:** This is 8 bits. Used for Type of Service, to let the Router Known what services should be provided to this packet.
- **Flow Label:** This is 20-bits; label is used to maintain the sequential flow of the packets belonging to a communication.
- **Payload Length:** This is 16-bit field. Is used to tell the routers how much information a particular packet contains in its payload.
- **Next header:** This field identifies the protocol to which the contents (data field) of this datagram will be delivered

(for example, to TCP or UDP).

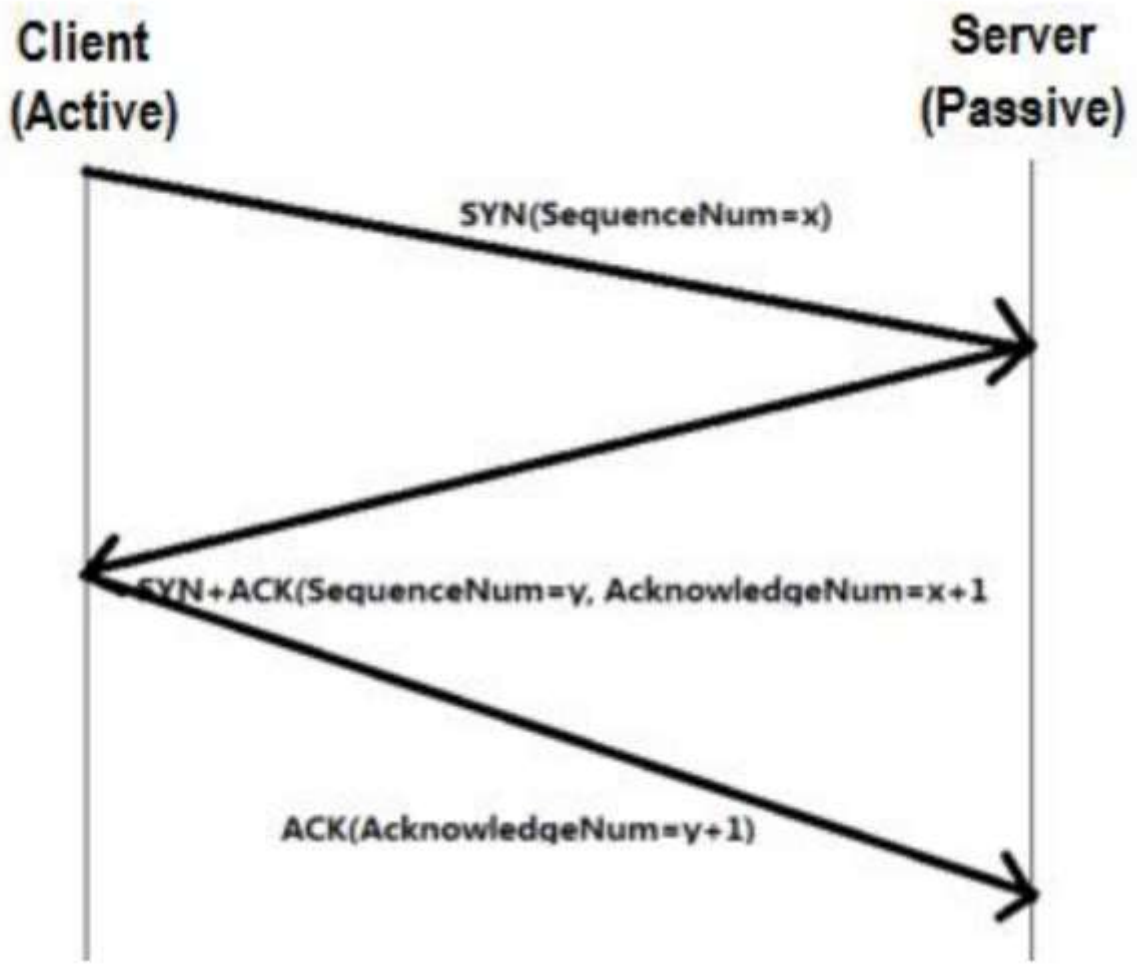
- **Hop Limit:** This is 8-bit field. Is used to stop packet to loop in the network infinitely. This is same as TTL in IPv4.
- **Source IP address:** The sender's IP address
- **Destination IP address:** This is the receiver's IP address

Three Way Handshake

1. The client (Active) sends the server a "synchronize" (SYN) message with its own **"sequence number x"**, which server receives.

2. Server (Passive) replies with a synchronize-acknowledgment (SYN-ACK) message with its own **"sequence number y"** and **"acknowledgement number x + 1"**, which client receives.

3. Client replies with an acknowledgment message with **"acknowledgement number y + 1"**, which server receives and to which he doesn't need to reply.



TCP and UDP Comparision

TCP	UDP
Connection-oriented	Connectionless
Sequenced	Un sequenced
Reliable	Unreliable
Has overheads	Low overhead
Windowing flow control	No windowing or flow control
Acknowledgments	No acknowledgment
Error Control	No Error Control

Thank you!!!