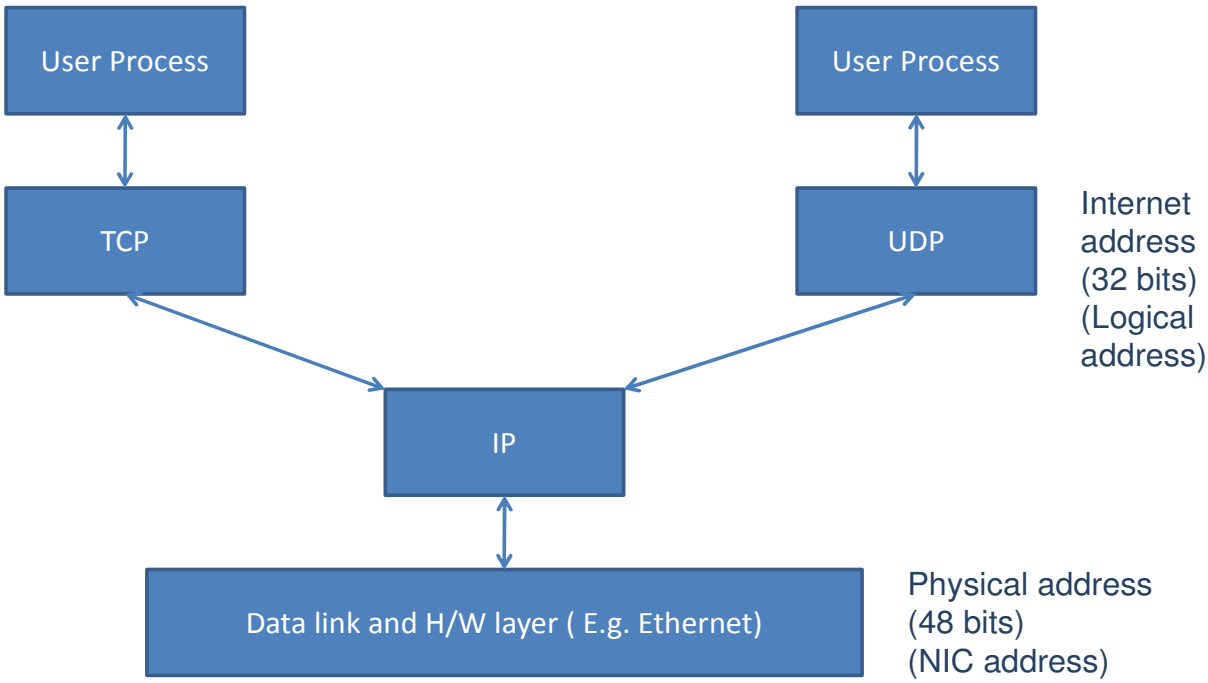
Address in TCP/IP:



Encapsulation:

- Basic Concept:
    1. As data flows down the protocol hierarchy, header (and trailer) gets appended to it.
    2. As data moves up the hierarchy, header (and trailer) gets stripped off.
- An example to illustrate:
    1. Trivial file transfer protocol (TFTP).
    2. TFTP client transfer 200 bytes of data.
    3. 4 bytes of TFTP header gets added.
- TFTP is the simpler version of FTP & uses UDP data.

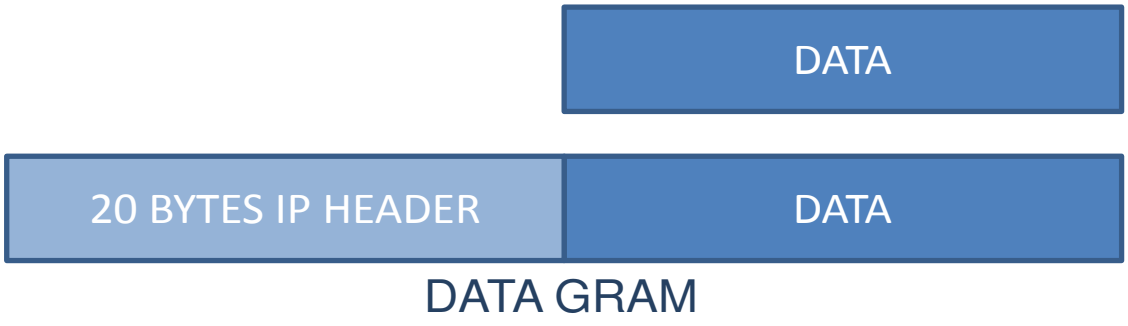
IP Datagram:

The IP Layer:

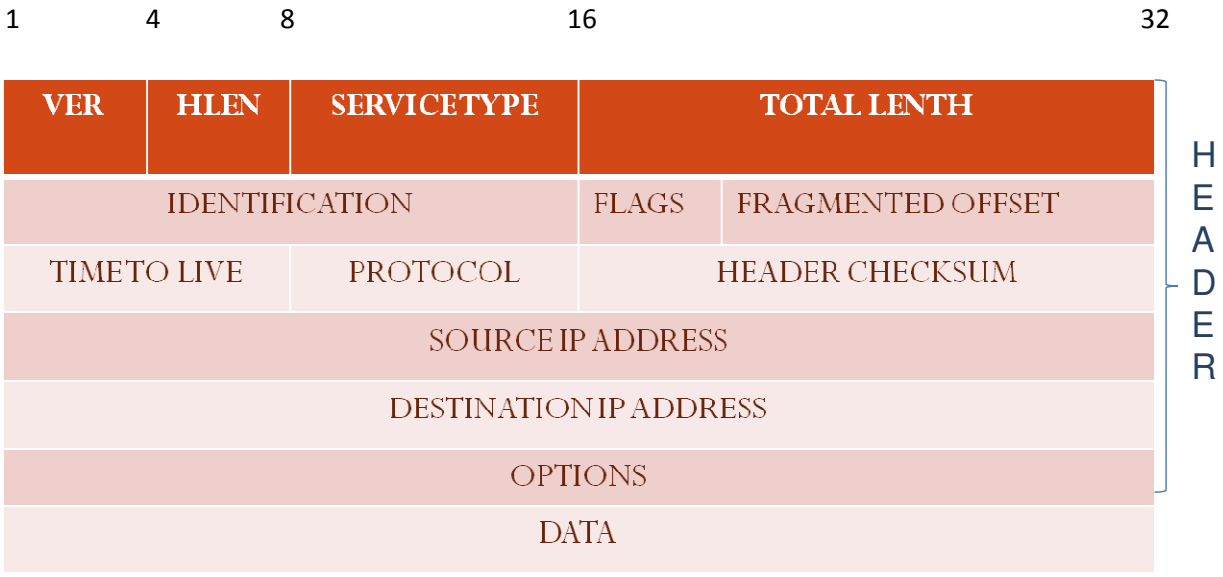
- IP layer provides a connectionless, unreliable delivery system for packets.

- Each packet is independent of one another.
- IP layer need not maintain any history.
- Each IP packet must contain the source and destination addresses.
- IP layer is a datagram service so IP layer does not guarantee delivery of packets.

- IP layer encapsulation:
  - Receives a Data chunk from the higher layer (TCP or UDP).
  - Appends a header of minimum 20 bytes.
    - Containing relevant information for handling routing & flow control.



DATA GRAM



Format of IP Datagram:

- VER(4 bits)
  - ❖ Version of the IP protocol in use (typically 4).
- HLEN (4 bits)
  - ❖ Length of the header expressed as the number of 32 bit words.
  - ❖ Minimum size is 5 and maximum 15.
- Total Length (16 bits): -
  - ❖ Length in bytes of the datagram including header.
  - ❖ Maximum datagram size is 216 = 65536 bytes.
- Service Type (8 bits)
  - ❖ Allowed packet to be assigned a priority.
  - ❖ Router can use this field to route packets.
  - ❖ Not universally used.
- Time to live (8 bits):
  - ❖ Prevents a packet from travelling in a loop
  - ❖ Sender sets a value that is decremented at each hop. If it reaches zero, packet is discarded.
- Protocol (8 bits):
  - ❖ Identifies the higher layer protocol being used.
- Source IP Address (32 bits)
  - ❖ Internet address of the sender.
- Destination IP address (32 bits)
  - ❖ Internet address of the destination.
- Identification, Flags, Fragment Offset :
  - ❖ Used for handling fragmentation.
- Options (Variable Width)

- ❖ Can be given provided router supports.
- ❖ Source routing, for example: -

Source can take decision for routing rather than intermediate nodes.

- Header Checksum (16 bits)
  - ❖ Covers only the IP header
  - ❖ How computed?
    1. Header treated as a sequence of 16 bit integers
    2. The integers are all added using ones complement arithmetic.
    3. Ones complement of the final sum is taken as the checksum.
  - ❖ A mismatch in checksum causes the datagram to be discarded.

Questions:

1. How many bits are there in the IP address?
2. How many bits are there in the Ethernet address?
3. What does the Ethernet address signify?
4. What does the IP address signify?
5. What does the port number signify?
6. What does the various layers in the simplified TCP/IP protocol stack correspond to with respect to the OSI 7-layer model?
7. Why is the transport layer called end-to-end or host-to-host layer?
8. IP is unreliable and TCP uses IP. How does TCP provide reliable service to the application layer?
9. List two common applications that use UDP?
10. Why is the IP protocol considered unreliable?
11. What does TCP do if the message to be sent larger than what a single datagram can handle?
12. If a 1000 byte data message is sent using TFTP, what will be the size in bytes of the corresponding Ethernet packet?
13. What are the minimum & maximum header sizes of an IP packet?

14. What is the purpose of the “Time to live” field in the IP header?

15. If the IP header is 192 bytes long, what will be the value of the “HLEN” field?

16. What is the maximum size of data that can be accommodated in an IP datagram?