

INTERNET PROTOCOL AND IP ADDRESSING

Internet Protocol

- It provides best effort, connectionless packet delivery, packets may be lost, out of order, or even duplicated, so it is the responsibility of higher layer protocols to deal with these, if necessary.
- The header is of fixed-length component of 20 bytes plus variable-length consisting of options that can be up to 40 bytes.

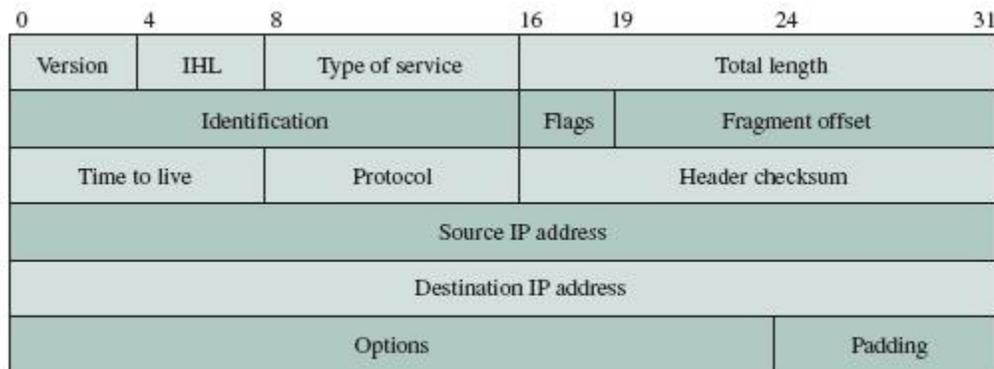


FIGURE 8.4 IP version 4 header

Version: This field identifies the current IP version and it is 4.

Internet header length (IHL): It specifies the length of the header in 32-bit words. If no options are used, IHL will have value of 5.

Type of service (TOS): This field specifies the priority of packet based on delay, throughput, reliability and cost. Three bits are used to assign priority levels and four bits are used for specific requirement (i.e. delay, throughput, reliability and cost).

Total length: The total length specifies the number of bytes of the IP packet including header and data, maximum length is 65535 bytes.

Identification, Flags, and Fragment Offset: These fields are used for fragmentation and reassembly.

Time to live (TTL): It specifies the number of hops; the packet is allowed to traverse in the network. Each router along the path to the destination decrements this value by one. If the value reaches zero before the packet reaches the destination, the router discards the packet and sends an error message back to the source.

Protocol: specifies upper-layer protocol that is to receive IP data at the destination. Examples include TCP (protocol = 6), UDP (protocol = 17), and ICMP (protocol = 1).

Header checksum: verifies the integrity of the IP header of the IP packet.

- IP header uses check bits to detect errors in the header
- A checksum is calculated for header contents
- Checksum recalculated at every router, so algorithm selected for ease of implementation in software

Source IP address and destination IP address: contain the addresses of the source and destination hosts.

Options: Variable length field allows packet to request special features such as security level, route to be taken by the packet, and timestamp at each router. Detailed descriptions of these options can be found in [RFC 791].

Padding: This field is used to make the header a multiple of 32-bit words.

IP Header Processing

1. Compute header checksum for correctness and check that fields in header (e.g. version and total length) contain valid values
2. Consult routing table to determine next hop
3. Change fields that require updating (TTL, header checksum)

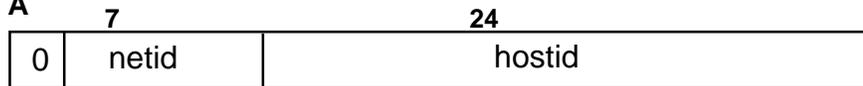
IP Addressing

- RFC 1166
- Each host on Internet has unique 32 bit IP address
- Each address has two parts: Netid and Hostid
- Netid is unique & administered by
 - American Registry for Internet Numbers (ARIN)
 - Reseaux IP Europeens (RIPE)
 - Asia Pacific Network Information Centre (APNIC)
- The Net ID identifies the network the host is connected to.
- The host ID identifies each individual system connected to network.
- Dotted Decimal Notation is used for representation:
- The IP address of 10000000 10000111 01000100 00000101 is 128.135.68.5 in dotted-decimal notation

Classful IP Addresses

- The IP address structure is divided into five address classes: Class A, Class B, Class C, Class D and Class E
- The class is identified by the Most Significant Bit (MSB) of the address as shown below.
- Class A has 7 bits for network IDs and 24 bits for host IDs, allowing up to 126 networks and about 16 million hosts per network.
- Class B has 14 bits for network IDs and 16 bits for host IDs, allowing about 16,000 networks and about 64,000 hosts per network.
- Class C has 21 bits for network IDs and 8 bits for host IDs, allowing about 2 million networks and 254 hosts per network.
- Class D addresses is used for multicast services that allow host to send information to a group of hosts simultaneously.
- Class E addresses are reserved for experiments.

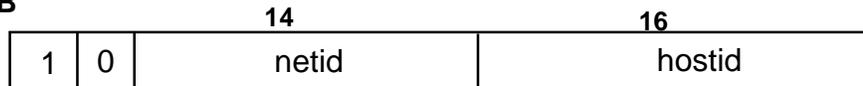
Class A



- 126 networks with up to 16 million hosts

**1.0.0.0 to
127.255.255.255**

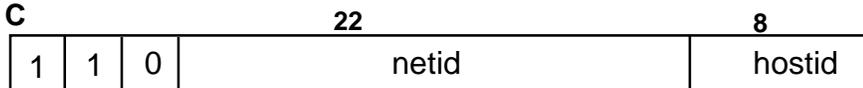
Class B



- 16,382 networks with up to 64,000 hosts

**128.0.0.0 to
191.255.255.255**

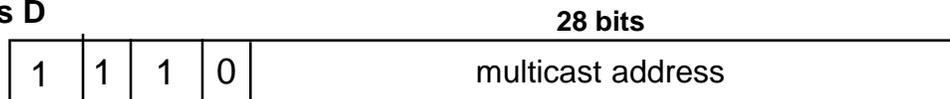
Class C



- 2 million networks with up to 254 hosts

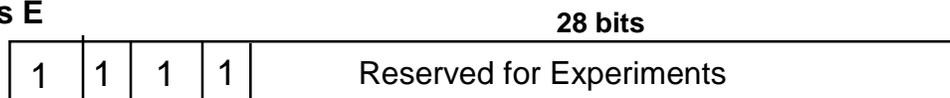
**192.0.0.0 to
223.255.255.255**

Class D



**224.0.0.0 to
239.255.255.255**

Class E



**240.0.0.0 to
254.255.255.255**

Subnet Addressing

- Subnet addressing was introduced in the mid 1980s when most large organizations are moving their computing platforms from mainframes to networks of workstations.
- Subnetting adds another level of hierarchical level called "Subnet".
- Inside the organization the network administrator can choose any combination of lengths for subnet and host ID fields.
- Example: - consider an organization that has been assigned a class B IP address with a network ID of 150.100. Suppose the organization has many LANS, each consisting of not more than 100 hosts. Then seven bits are sufficient to uniquely identify each host in a subnetwork. The other nine bits can be used to identify the subnetworks within organization
- To find the subnet number, the router needs to store an additional quantity called subnet mask, which consists of binary 1s for every bit position of the address except the host ID field where binary 0s are used.
- For the IP address 150.100.12.176, the subnet mask is 11111111 11111111 11111111 10000000, which corresponds to 255.255.255.128.

- The router can determine the subnet number by performing a binary AND between subnet mask and the IP address.

The IP address is 10010110 01100100 00001100 10110000 i.e. 150.100.12.176
AND with subnet mask 11111111 11111111 11111111 10000000 i.e. 255.255.255.128
to get subnet number 10010110 01100100 00001100 10000000 i.e. 150.100.12.128
and which is also called as First Address and is used to identify the subnetwork inside
the organization.

- The IP address 150.100.12.255 is used to broadcast packets inside the subnetwork.
Thus the host connected to subnetwork must have IP address in the range
150.100.12.129 to 150.100.12.254.

Source : <http://elearningatria.files.wordpress.com/2013/10/unit2.pdf>