Computer Networks

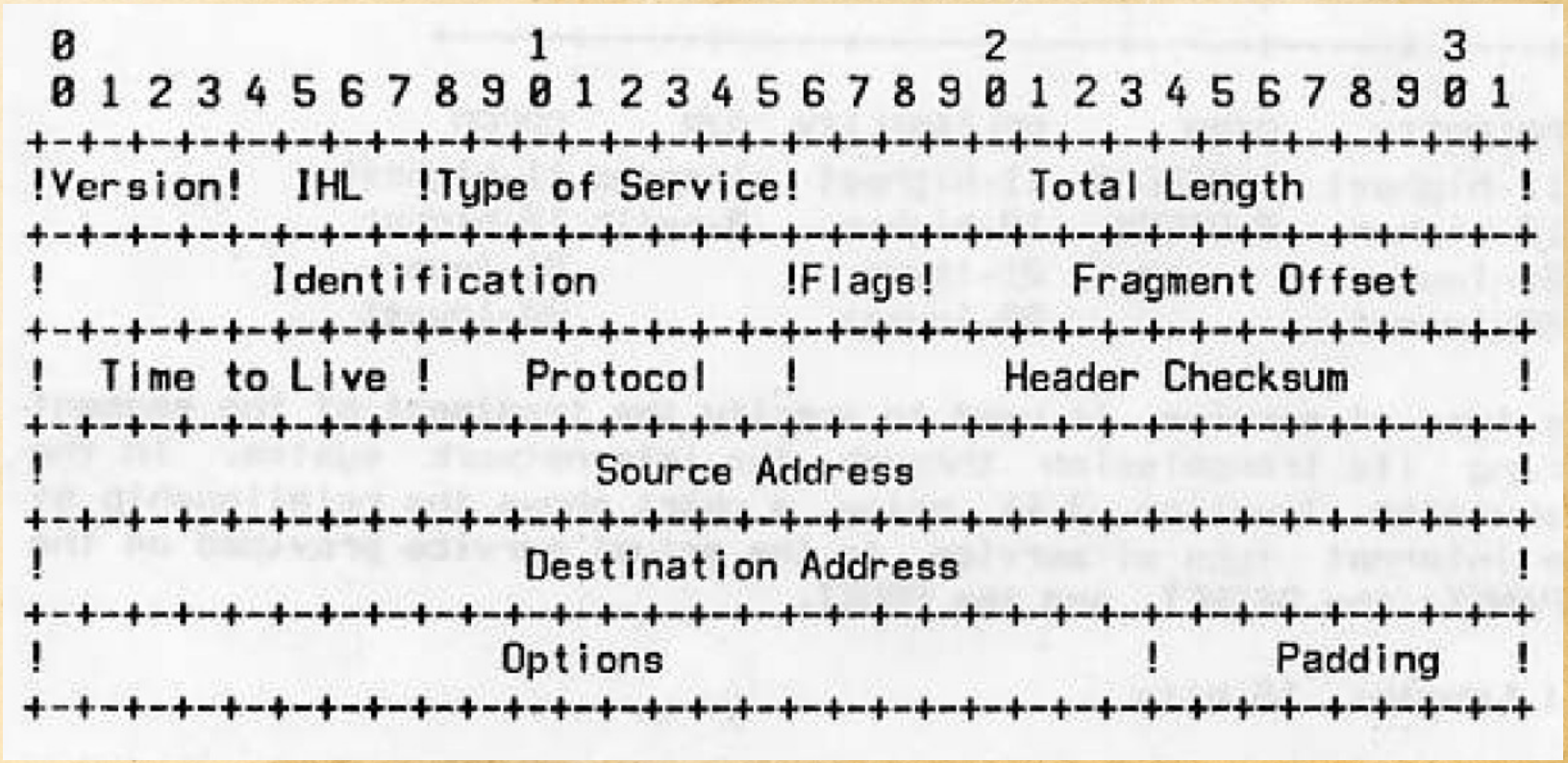
Internet Protocol version 4 (IPv4) Header

Lecture Contents

- IPv4 header
  - Version
  - Internet Header Length (IHL)
  - Type of Service
  - Total Length
  - Identification
  - Flags
  - Fragment Offset
  - Time to Live (TTL)
  - Protocol
  - Header Checksum
  - Source Address
  - Destination Address

Internet Protocol version 4 (IPv4)

- Header given in ***IEN 54*** (and *RFC 760*)



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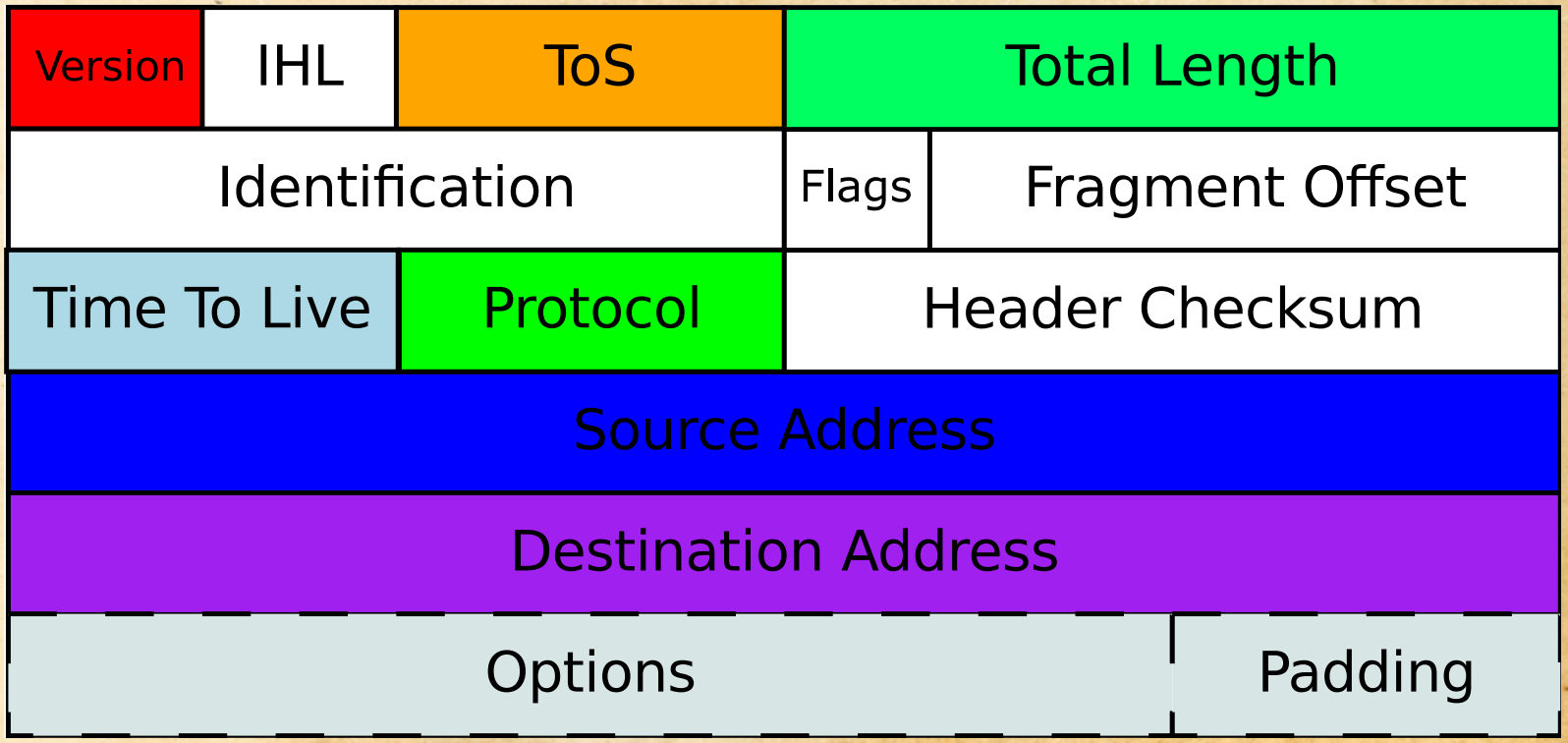

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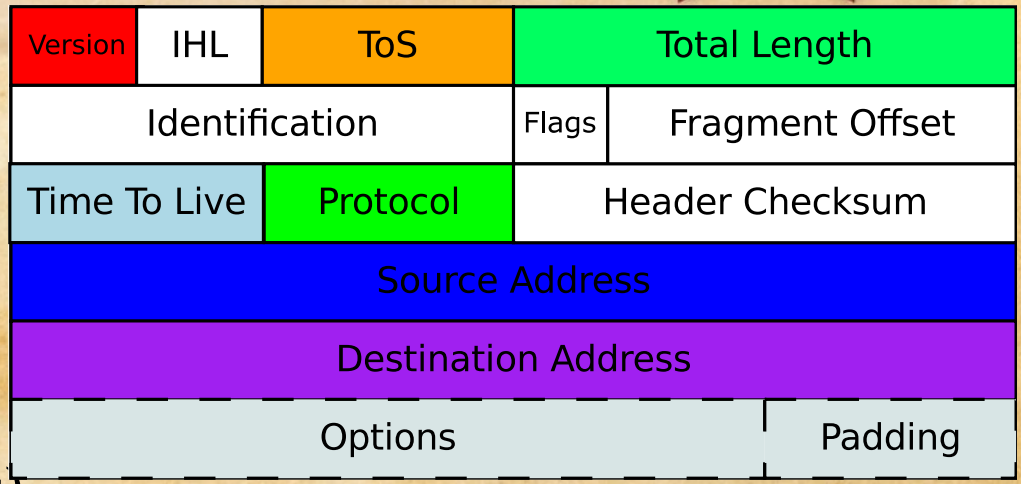

- **Version** (4 bits)
  - Set to 4: **`0100`**
- **IHL**: *Internet Header Length* (4 bits)
  - Length in 32-bit words
  - Minimum 5, maximum 15 (60 bytes)
  - Points to beginning of data
- **ToS**: Type of Service (8 bits)
  - Parameters of the *quality of service* desired
    - e.g.: speed versus reliability

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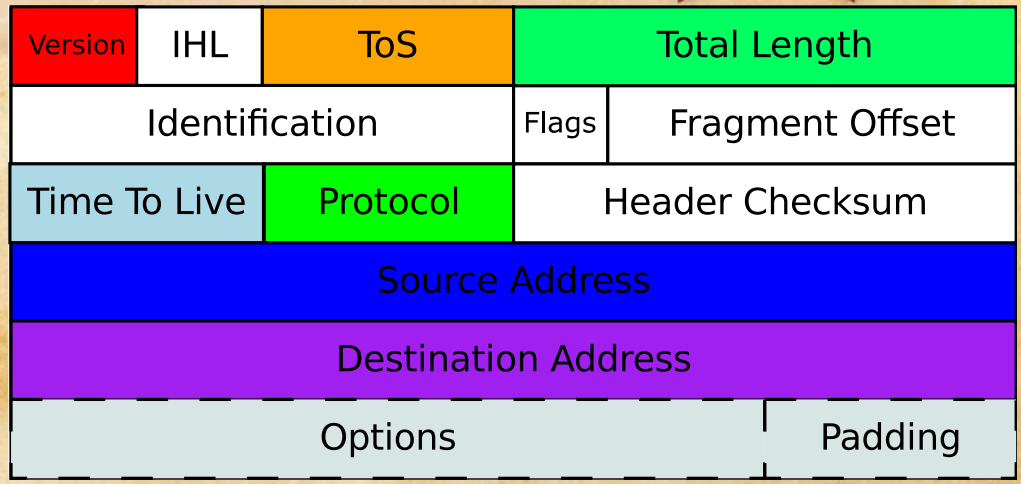

- **Total Length** (16 bits)
  - Length in bytes of datagram
  - Includes header, data
  - 16 bits = 65,535 bytes (impractical)
  - Host must accept 576-byte
    - 64-byte header, 512-byte data
- **Identification** (4 bits)
  - Assigned by sender to aid in assembling the fragments of a datagram

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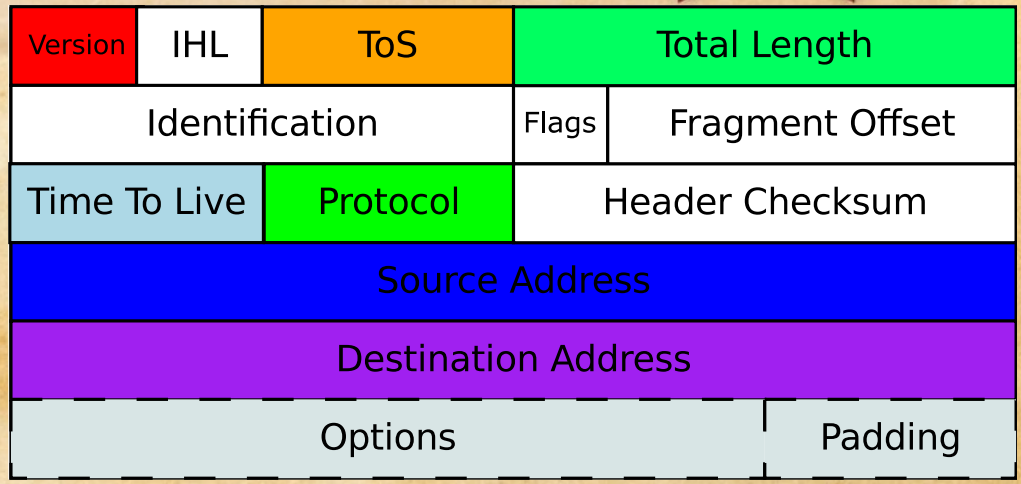

- **Flags** (3 bits)
  - [0] – reserved; must be zero
  - [1] – don't fragment
    - Host can't reassemble
    - Maximum transmission Unit (MTU) discovery
  - [2] – more fragments
    - All fragmented packets except the last
- **Fragment Offset** (13 bits)
  - Units of 8 bytes (fragment length must be a multiple of 8 bytes)
    - $(2^{13} = 8192)$ x $(2^3 = 8$ bytes$) = 65536$

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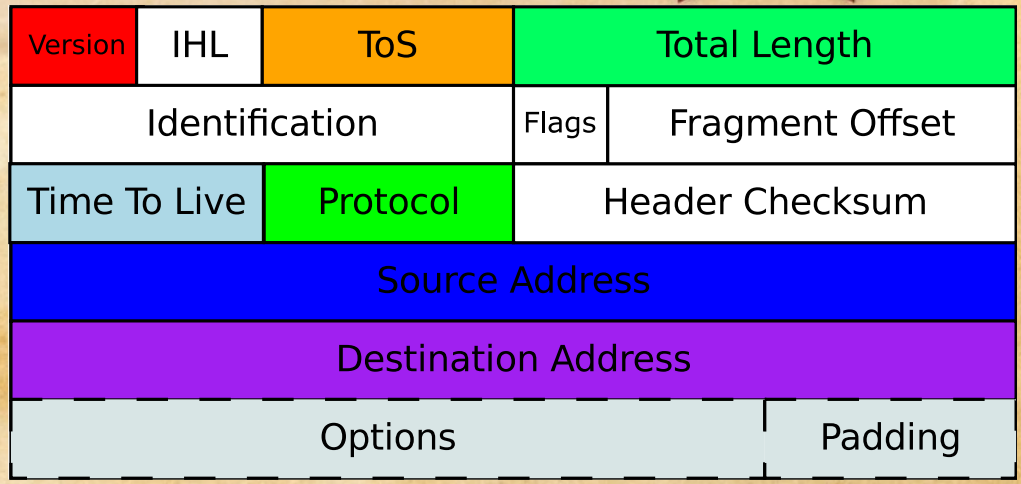

- **Time to Live** (8 bits)
  - Prevent network loop from causing network failure
  - Time in seconds
  - In practice, hop count
  - When exceeded, *Internet Control Message Protocol* (ICMP) message *time exceeded* sent to sender
  - Program *traceroute* sends messages with adjusted TTL values and uses *ICMP time exceeded messages* to identify the routers traversed by packets

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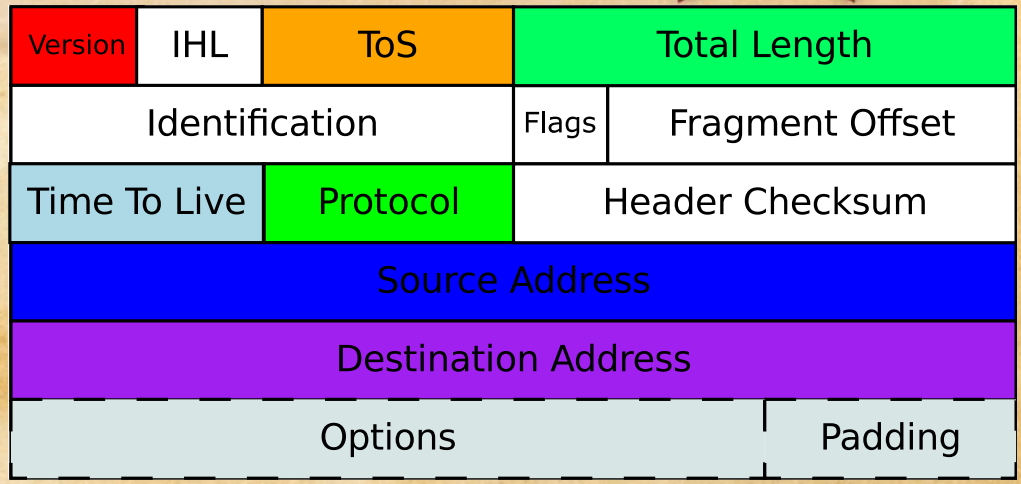

- **Protocol** (8 bits)
  - `0x01`: ICMP
  - `0x06`: TCP
  - `0x11`: UDP
  - `0x21`: DCCP – data congestion control protocol
  - `0x29`: IPv6 – IPv6 encapsulation

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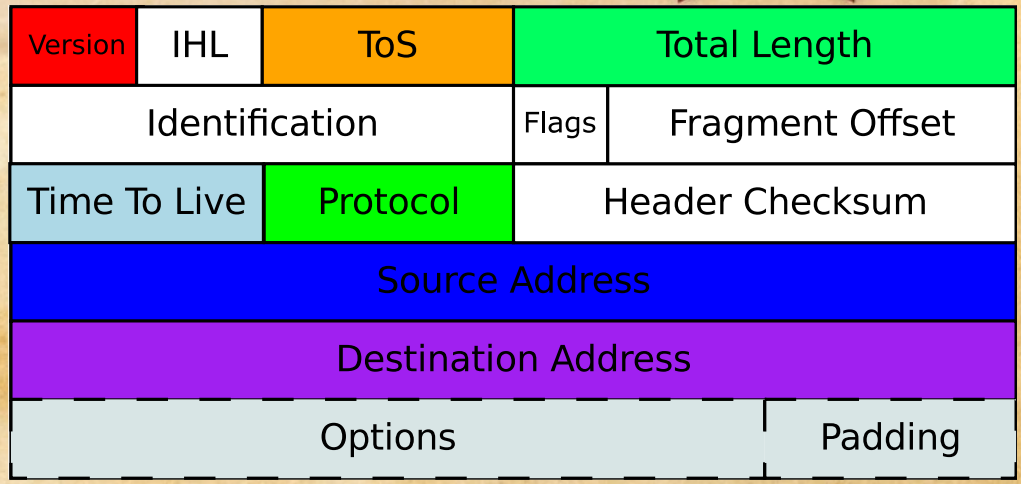

- **Header Checksum** (16 bits)
  - TCP/UDP have checksums for data
  - Recomputed when TTL changes
  - 16-bit one's complement of the one's complement sum of all 16-bit words in the header. For purposes of computing the checksum, the checksum field is zero.
  - Receiving, the sum of the entire IP header should be zero.

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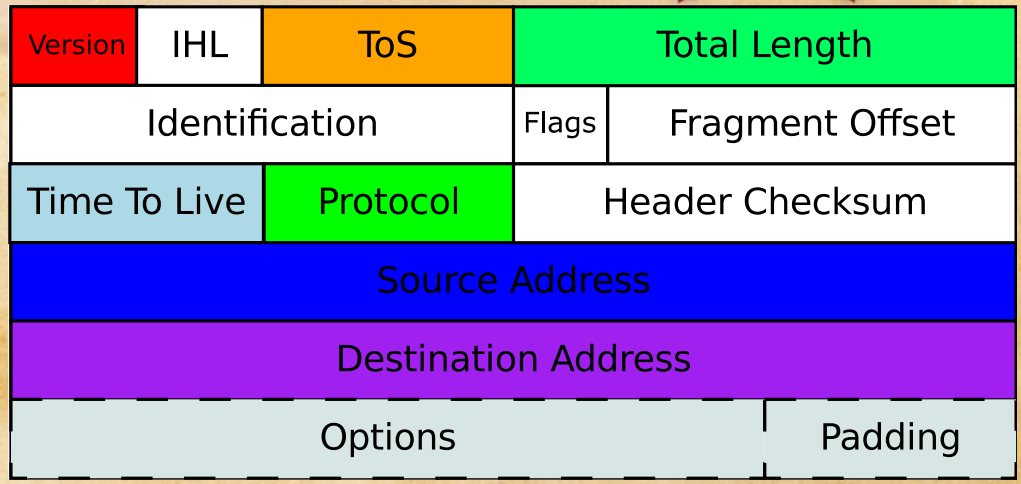
- **Source Address** (32 bits)
  - 192.168.100.1
- **Destination Address** (32 bits)



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