IPv4 Header Format

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Connectionless Vs Connection-oriented Service

- TCP/IP's fundamental delivery service is connectionless
- Individual packets travel independently and contains information that identifies the intended recipient
- A reliable connection-oriented service is added on top of the underlying connectionless service

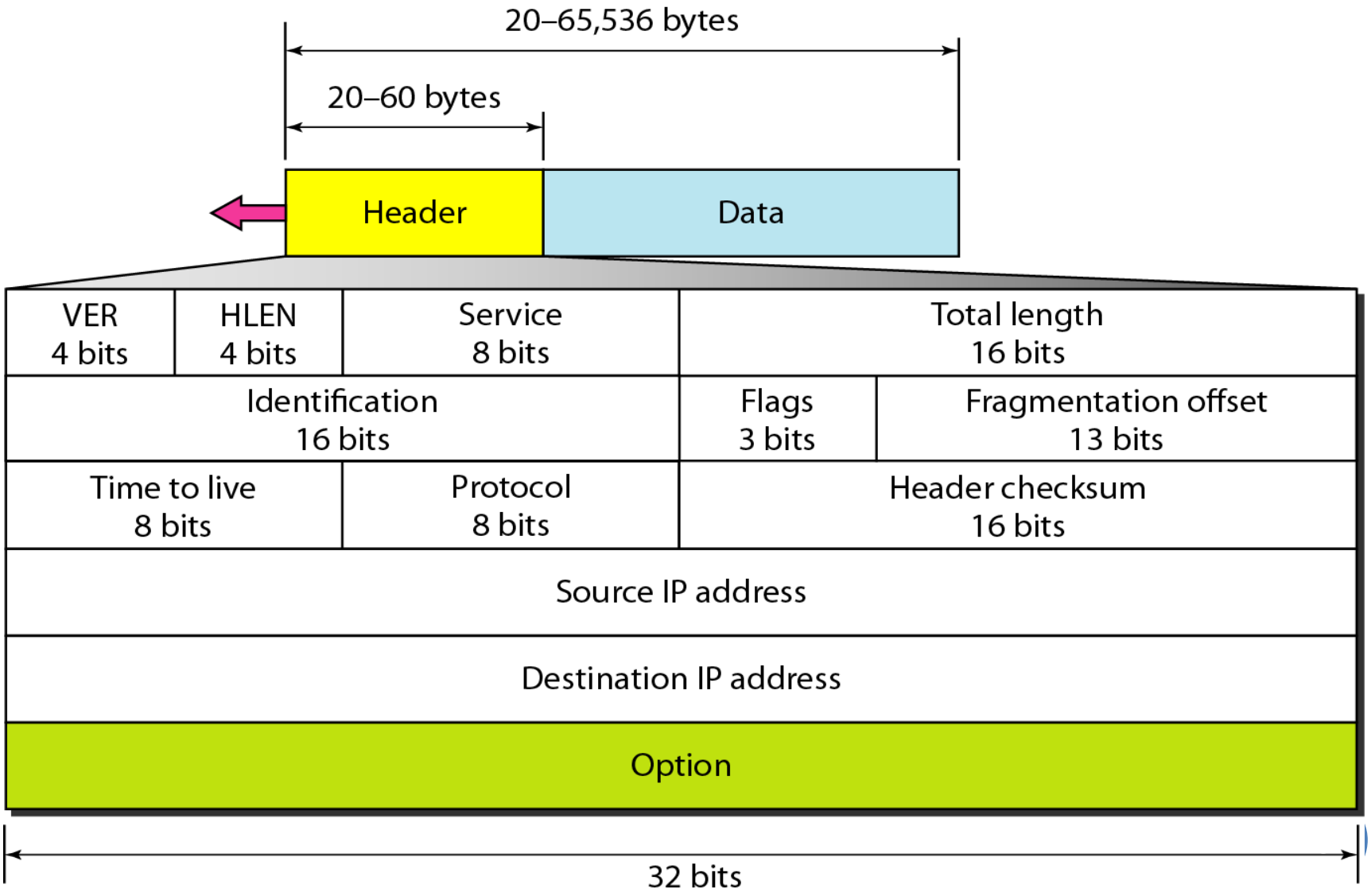
DATAGRAM FORWARDING ACROSS HETEROGENEOUS NETWORKS

- Heterogeneous networks use different frame formats
- Router cannot forward a frame from one type of network to another without modification
- Two networks may use incompatible address formats (ie. address in a frame may make no sense on another network).

Unreliable Datagram Delivery

- IP makes a best-effort attempt to deliver each datagram
- No guarantee of datagram delivery
- Problems that can occur at layer 3
  - datagram duplication due to excessive delay
  - out-of-order delivery
  - data corruption
  - datagram loss
- Higher layers of protocol software are needed to handle these errors.

IP Datagram Header Format [Source: *TCP/IP Protocol Suite by Forouzan*]



Service type or differentiated services[Source:TCP/IP Protocol Suite by Forouzan]

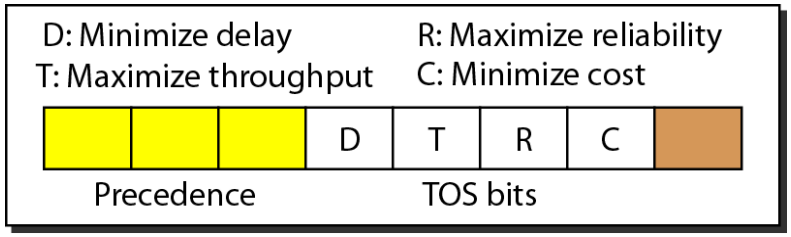
Protocol	*TOS Bits*	*Description*
ICMP	0000	Normal
BOOTP	0000	Normal
NNTP	0001	Minimize cost
IGP	0010	Maximize reliability
SNMP	0010	Maximize reliability
TELNET	1000	Minimize delay
FTP (data)	0100	Maximize throughput
FTP (control)	1000	Minimize delay
TFTP	1000	Minimize delay
SMTP (command)	1000	Minimize delay
SMTP (data)	0100	Maximize throughput
DNS (UDP query)	1000	Minimize delay
DNS (TCP query)	0000	Normal
DNS (zone)	0100	Maximize throughput

Note

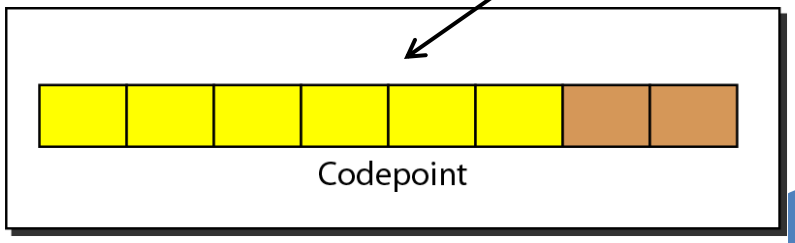
The precedence subfield was part of version 4, but never used.

TOS Bits	*Description*
0000	Normal (default)
0001	Minimize cost
0010	Maximize reliability
0100	Maximize throughput
1000	Minimize delay

Value	*Protocol*
1	ICMP
2	IGMP
6	TCP
17	UDP
89	OSPF



Service type



Differentiated services

IP DATAGRAM HEADER(CONT.)

- **Version**:This 4-bit field defines the version of the IP protocol. Currently the version is 4.
- **Header Length**:This 4-bit field defines the total length of the datagram header in 4-byte words. This field is needed because the length of the header is variable (between 20 and 60 bytes).
- **Service Type**: In the original design of IP header, this field was referred to as **type of service (TOS)** , which defined how the datagram should be handled.
- **Total Length (16 bits):** Total length of the datagram, measured in octets, including header and data.

- **Identification (16 bits)**: A value assigned to aid in assembly of fragments.
- **Flags (3 bits)**: Various Control Flags.
  - Bit 0: Reserved. Must be 0.
  - Bit 1: (DF) 0 = May Fragment, 1 = Don't Fragment
  - Bit 2: (MF) 0 = Last Fragment, 1 = More Fragments
- **Time to Live (8 bits):** Maximum time the datagram is allowed to exist in the system. Each router that handles the datagram decrements the TTL by 1.

- **Protocol:**This 8-bit field defines the higher-level protocol that uses the services of the IP layer. An IP datagram can encapsulate data from several higher level protocols such as TCP, UDP, ICMP, and IGMP.
- **Checksum:** It is used to detect error in the delivery of packet.
- **Source address:**This 32-bit field defines the IP address of the source.
- **Destination address:**This 32-bit field defines the IP address of the destination.

Numerical 1:

An IPv4 packet has arrived with the first 8 bits as shown:

01000010

The receiver discards the packet. Why?

Solution

There is an error in this packet. The 4 leftmost bits (0100) show the version, which is correct. The next 4 bits (0010) show an invalid header length ($2 \times 4 = 8$). The minimum number of bytes in the header must be 20. The packet has been corrupted in transmission.