COMPUTER COMMUNICATION NETWORKS

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IPv4 Datagram Format and Datagram Fragmentation

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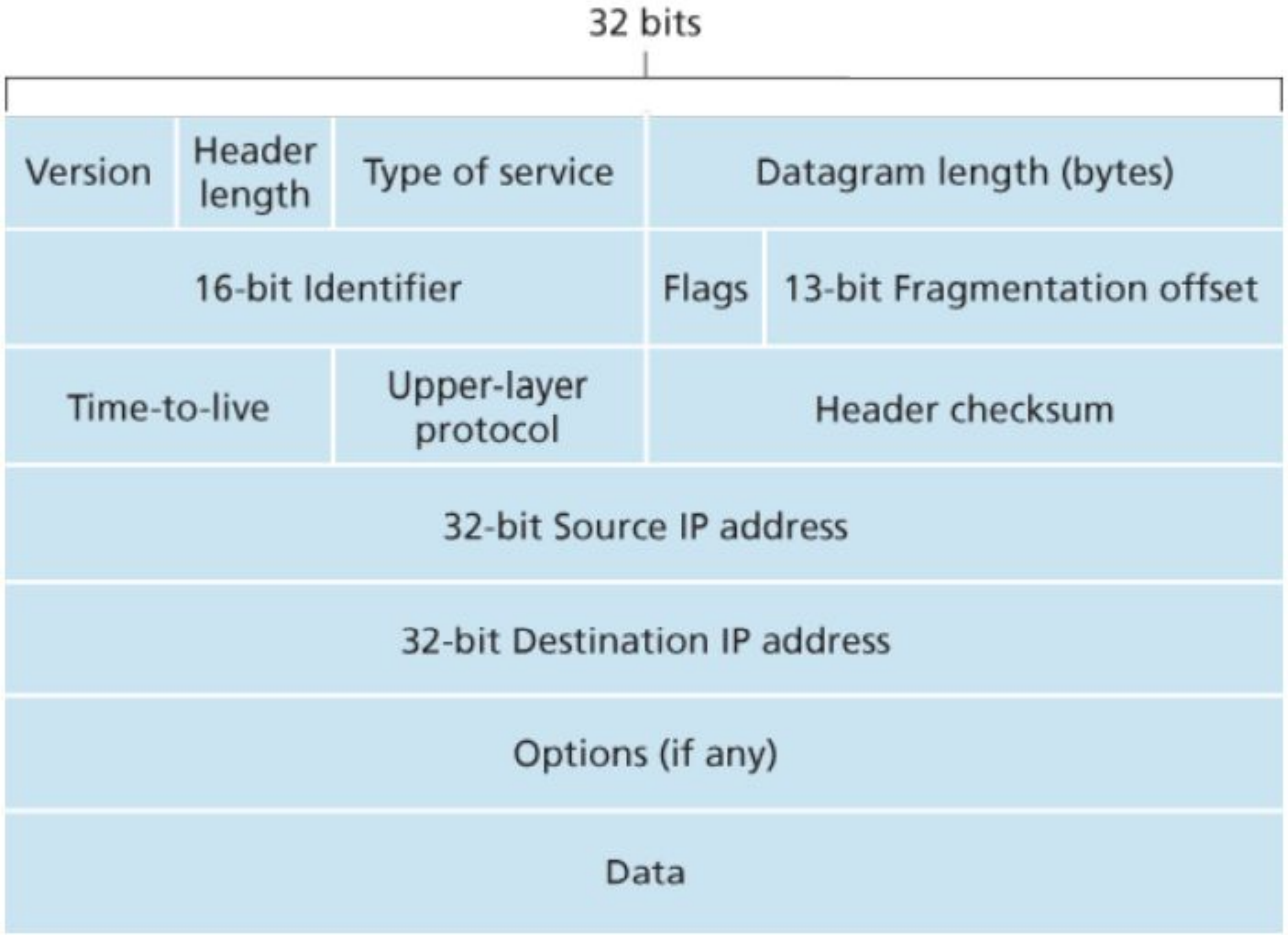
IP Address Formats

There are two versions of IP address formats:

- IPv4 Addressing format
- IPv6 Addressing format

IPv4 Datagram Format



IPv4 Datagram Format

Version number: These 4 bits specify the IP protocol version of the datagram. By looking at the version number, the router can determine how to interpret the remainder of the IP datagram.

Header length: Because an IPv4 datagram can contain a variable number of options (which are included in the IPv4 datagram header), these 4 bits are needed to determine where in the IP datagram the payload (e.g., the transport-layer segment being encapsulated in this datagram) actually begins.

IPv4 Datagram Format

Type of service: The type of service (TOS) bits were included in the IPv4 header to allow different types of IP datagrams to be distinguished from each other.

For example, it might be useful to distinguish real-time datagrams (such as those used by an IP telephony application) from non-real time traffic (for example, FTP).

Datagram length: This is the total length of the IP datagram (header plus data), measured in bytes. Since this field is 16 bits long, the theoretical maximum size of the IP datagram is 65,535 bytes.

IPv4 Datagram Format

Identifier: This 16 bit field is primarily used for uniquely identifying the group of fragments of a single IP datagram

Flags: A three-bit field follows and is used to control or identify fragments. They are (in order, from most significant to least significant):

- bit 0: Reserved; must be zero.
- bit 1: Don't Fragment (DF)
- bit 2: More Fragments (MF)

IPv4 Datagram Format

Time-to-live: The time-to-live (TTL) field is included to ensure that datagrams do not circulate forever (due to, for example, a long-lived routing loop) in the network. This field is decremented by one each time the datagram is processed by a router. If the TTL field reaches 0, a router must drop that datagram

Protocol: This 8 bits field is typically used only when an IP datagram reaches its final destination. The value of this field indicates the specific transport-layer protocol to which the data portion of this IP datagram should be passed.

- For example: A decimal value of 6 indicates that the data portion is passed to TCP ,a decimal value of 17 indicates that the data is passed to UDP.

IPv4 Datagram Format

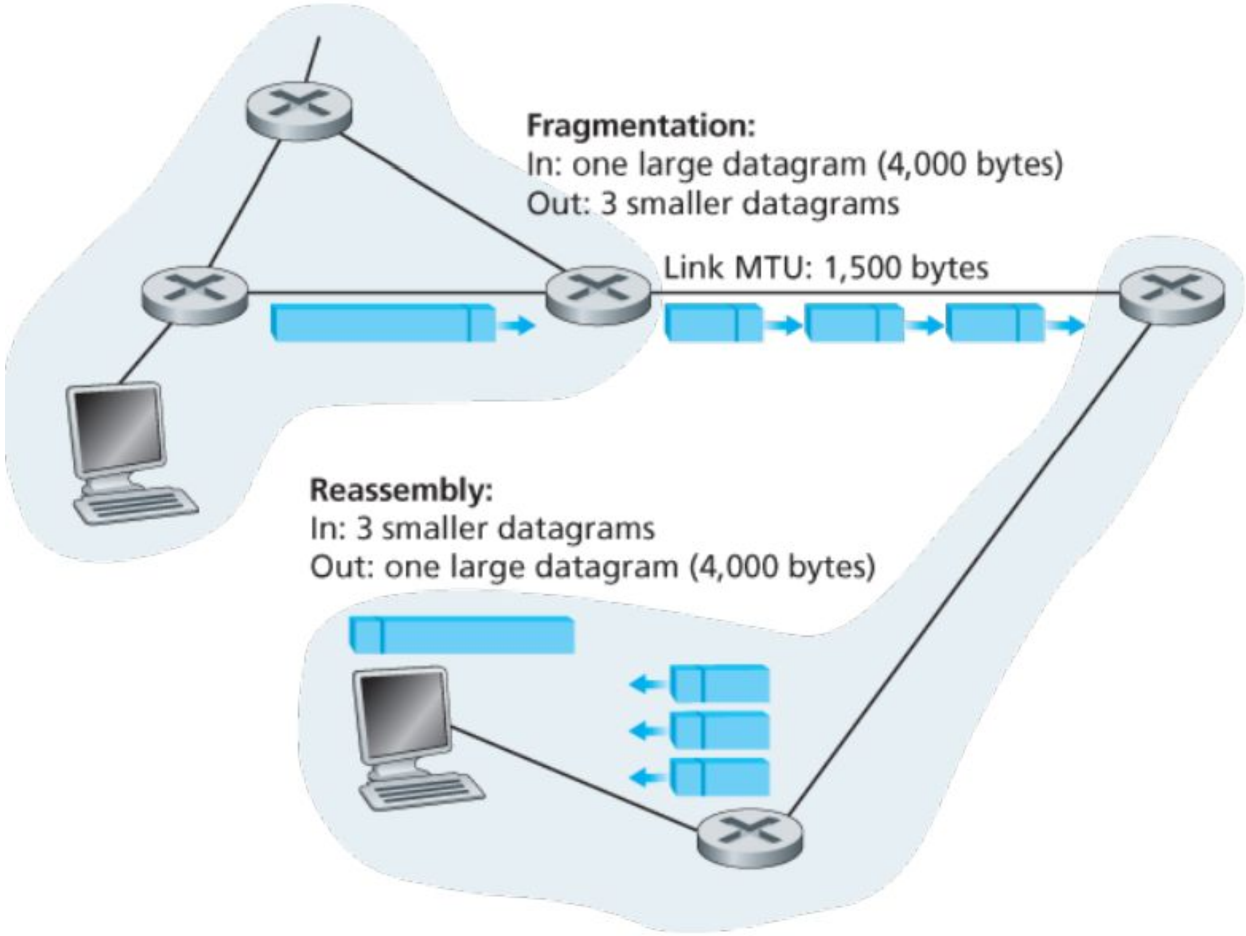
Header checksum: The 16 bit header checksum aids a router in detecting bit errors in a received IP datagram.

Source and destination IP addresses (32 bit length): When a source creates a datagram, it inserts its IP address into the source IP address field and inserts the address of the ultimate destination into the destination IP address field.

Options: The options fields allow an IP header to be extended.

Data (payload): The data field of the IP datagram contains the transport-layer segment (TCP or UDP) to be delivered to the destination. However, the data field can carry other types of data, such as ICMP messages

IPv4 Datagram Fragmentation



IPv4 Datagram Fragmentation

- The maximum amount of data that a link-layer frame can carry is called the **maximum transmission unit (MTU).**

- The solution to squeeze the oversized IP datagram is to **fragment the payload** in the IP datagram into two or more smaller IP datagrams. Host never performs the fragmentation, intermediate nodes will perform fragmentation

- These **smaller datagrams are referred to as fragments**. Fragments need to be reassembled at the destination host before they reach the transport layer.

IPv4 Datagram Fragmentation (Cont..)

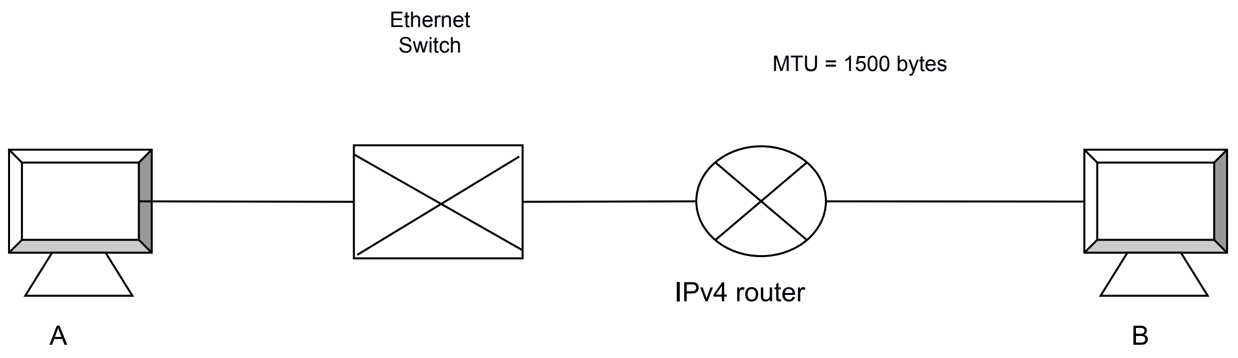
- Datagram length: 4000 bytes
- MTU: 1500 bytes
- Fragmented datagram and original datagram should account for IP header (20 bytes)
- Use Identification, Offset and More fragments (MF) flag

Fragment (payload)	Identification (16 bits)	Offset (13 bits)	MF (1 bit)
1 (1480 bytes)	777	0	1
2 (1480 bytes)	777	185	1
3 (1020 bytes)	777	370	0

IPv4 Datagram Format and Datagram Fragmentation

Numerical 1:

Suppose host A sends an IPv4 datagram of length 4500 bytes (including the typical IPv4 header) to host B. Write the datagram length (bytes), fragmentation offset, value of the more fragments flag of each datagram received by host B.



IPv4 Datagram Format and Datagram Fragmentation

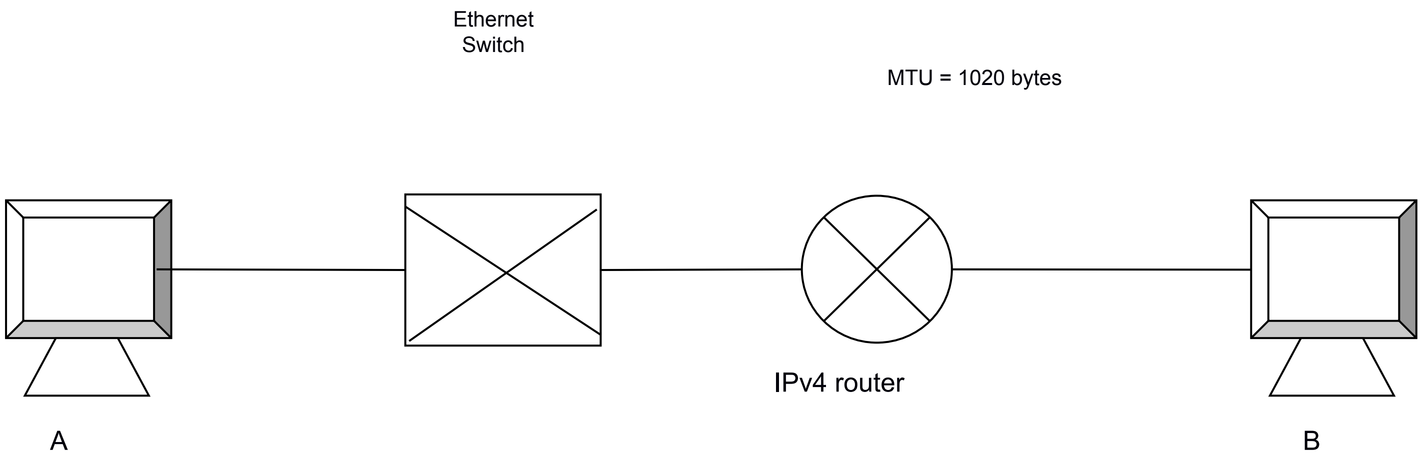
Solution

S. No.	Datagram length	Fragmentation offset	MF bit
1	1480	0	1
2	1480	185	1
3	1480	370	1
4	40	555	0

IPv4 Datagram Format and Datagram Fragmentation

Numerical 2:

Suppose host A sends an IPv4 datagram of length 4500 bytes (including the typical IPv4 header) to host B. Write the datagram length (bytes), fragmentation offset, value of the more fragments flag of each datagram received by host B.



Solution

S. No.	Datagram length	Fragmentation offset	MF bit
1	1000	0	1
2	1000	125	1
3	1000	250	1
4	1000	375	1
5	500	500	0

THANK YOU

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