Consider an Ethernet segment with a transmission speed of 10^8 bits/sec and a maximum segment length of 500 meters. If the speed of propagation of the signal in the medium is 2×10^8 meters/sec, then the minimum frame size (in bits) required for collision detection is _____

A 400

B 450

C 500

D 550

Consider a network path $\mathrm{P} - \mathrm{Q} - \mathrm{R}$ between nodes P and R via router Q. Node P sends a file of size 10^6 bytes to R via this path by splitting the file into chunks of 10^3 bytes each. Node P sends these chunks one after the other without any wait time between the successive chunk transmissions. Assume that the size of extra headers added to these chunks is negligible, and that the chunk size is less than the MTU. Each of the links $\mathrm{P} - \mathrm{Q}$ and $\mathrm{Q} - \mathrm{R}$ has a bandwidth of $10^6 \mathrm{bits/sec}$, and negligible propagation latency. Router Q immediately transmits every packet it receives from P to R, with negligible processing and queueing delays. Router Q can simultaneously receive on link $P - Q$ and transmit on $\mathrm{link}\, Q - R$.
Assume P starts transmitting the chunks at time $t = 0$. Which one of the following options gives the time (in seconds, rounded off to 3 decimal places) at which R receives all the chunks of the file?

A 8

B 8.008

C 15.992

D 16

Suppose two hosts are connected by a point-to-point link and they are configured to use Stop-and-Wait protocol for reliable data transfer. Identify in which one of the following scenarios, the utilization of the link is the lowest.

A Longer link length and lower transmission rate

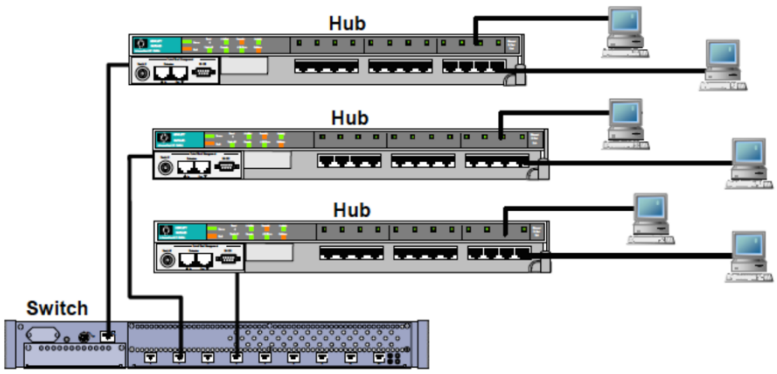
B Longer link length and higher transmission rate

C Shorter link length and lower transmission rate

D Shorter link length and higher transmission rate

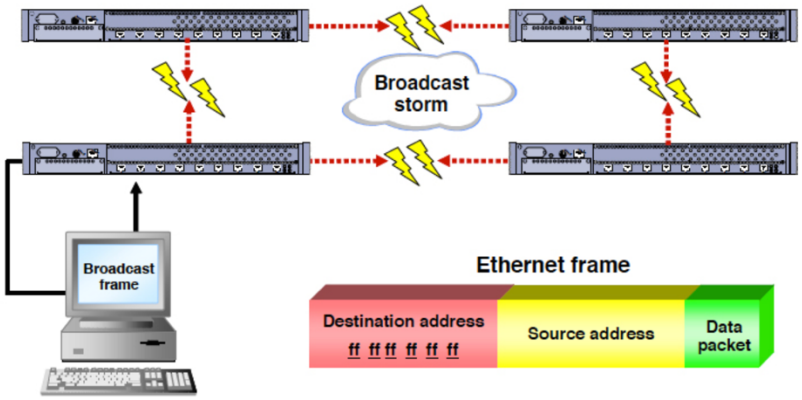
Difference between Hub, Switch and Bridge

The key difference between hubs, switches and bridges is that hubs operate at Layer 1 of the OSI model, while bridges and switches work with MAC addresses at Layer 2. Hubs broadcast incoming traffic on all ports, whereas bridges and switches only route traffic towards their addressed destinations.



In the physical world, a bridge connects roads on separate sides of a river or railroad tracks. In the technical world, bridges connect two physical network segments. Each network bridge keeps track of the MAC addresses on the network attached to each of its interfaces. When network traffic arrives at the bridge and its target address is local to that side of the bridge, the bridge filters that Ethernet frame, so it stays on the local side of the bridge only.

If the bridge is unable to find the target address on the side that received the traffic, it forwards the frame across the bridge, hoping the destination will be on the other network segment. At times, there are multiple bridges to cross to get to the destination system.

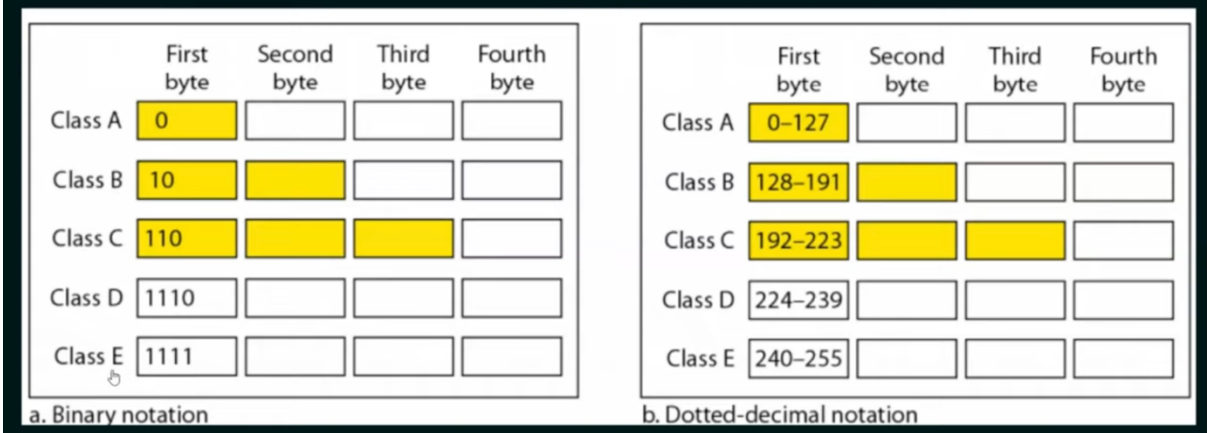


The Ethernet frame structure is defined in the IEEE 802.3 standard. Here is a graphical representation of an Ethernet frame and a description of each field in the frame:

Preamble	SFD	Destination MAC	Source MAC	Type	Data and Pad	FCS
7 Bytes	1 Byte	6 Bytes	6 Bytes	2 Bytes	46-1500 Bytes	4 Bytes

- **Preamble** – informs the receiving system that a frame is starting and enables synchronisation.
- **SFD (Start Frame Delimiter)** – signifies that the Destination MAC Address field begins with the next byte.
- **Destination MAC** – identifies the receiving system.
- **Source MAC** – identifies the sending system.
- **Type** – defines the type of protocol inside the frame, for example IPv4 or IPv6.
- **Data and Pad** – contains the payload data. Padding data is added to meet the minimum length requirement for this field (46 bytes).
- **FCS (Frame Check Sequence)** – contains a 32-bit Cyclic Redundancy Check (CRC) which allows detection of corrupted data.

Classes of IPv4 address



Classes of IPv4 address

Address Class	1st Octet range in decimal	1st Octet bits (Blue Dots do not change)	Network (N) and Host (H) Portion	Default mask (Decimal)	Number of possible networks and hosts per network
A	0–127	00000000 - 01111111	N.H.H.H	255.0.0.0	128 Nets (2^7) 16,777,214 hosts ($2^{24}-2$)
B	128–191	10000000 - 10111111	N.N.H.H	255.255.0.0	16,384 Nets (2^{14}) 65,534 hosts ($2^{16}-2$)
C	192–223	11000000 - 11011111	N.N.N.H	255.255.255.0	2,09,150 Nets (2^{21}) 254 hosts (2^8-2)
D	224–239	11100000 - 11101111	NA (Multicast)	-	-
E	240–255	11110000 - 11111111	NA (Experimental)	-	-

Subnet mask (Slash notation)

Class	Subnet Mask (in Decimal)	Subnet Mask (in Binary)	Slash Notation
A	255.0.0.0	11111111.00000000.00000000.00000000	/8
B	255.255.0.0	11111111.11111111.00000000.00000000	/16
C	255.255.255.0	11111111.11111111.11111111.00000000	/24

Broadcast transmission

Broadcast Transmission: The process of sending a packet from one host to all hosts in the network.

Limited Broadcast:

Destination: 255.255.255.255

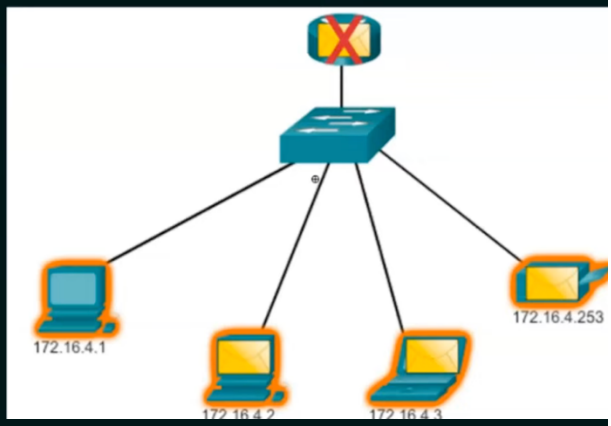
Routers do not forward a limited broadcast!

Directed broadcast:

Destination: 172.16.4.255

Hosts within the 172.16.4.0/24 network!

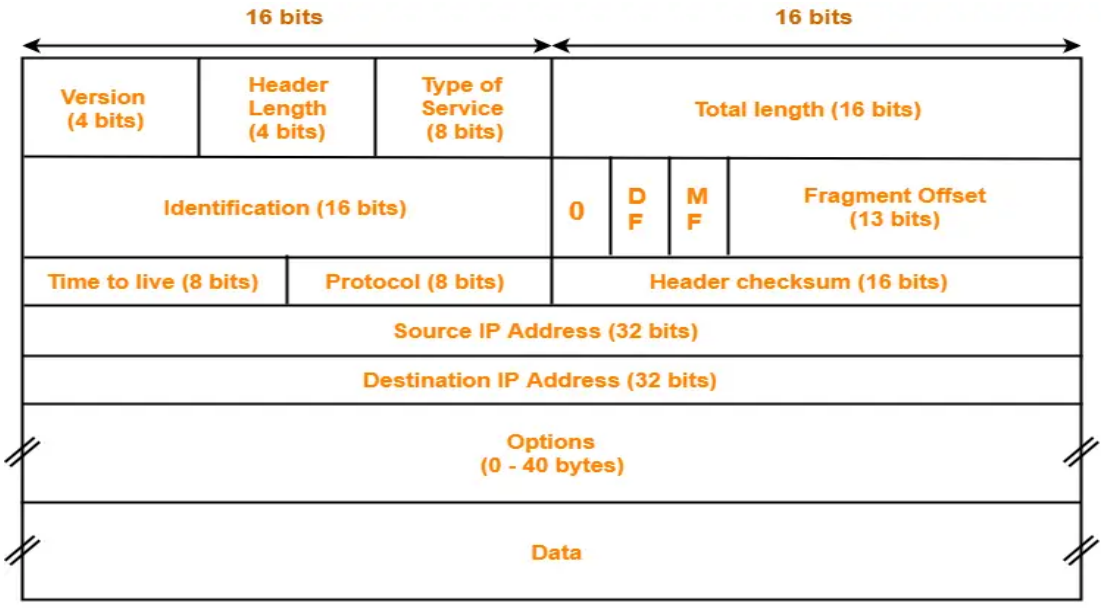
Source: 172.16.4.1
Destination: 255.255.255.255



Multicast transmission

Multicast Transmission: The process of sending a packet from one host to a selected group of hosts, possibly in different networks.

- ★ Multicast transmission reduces traffic
- ★ The Multicast Address range: 224.0.0.0 to 239.255.255.255
- ★ Link local – 224.0.0.0 to 224.0.0.255 (Example: routing information exchanged by routing protocols)
- ★ Globally scoped addresses – 224.0.1.0 to 238.255.255.255 (Example: 224.0.1.1 has been reserved for Network Time Protocol)



IPv4 Header

Which one of the following CIDR prefixes exactly represents the range of IP addresses 10.12.2.0 to 10.12.3.255?

A 10.12.2.0/23

B 10.12.2.0/24

C 10.12.0.0/22

D 10.12.2.0/22

Which of the following fields of an IP header is/are always modified by any router before it forwards the IP packet?

A Source IP Address

B Protocol

C Time to Live (TTL)

D Header Checksum

Node X has a TCP connection open to node Y. The packets from X to Y go through an intermediate IP router R. Ethernet switch S is the first switch on the network path between X and R. Consider a packet sent from X to Y over this connection.
Which of the following statements is/are TRUE about the destination IP and MAC addresses on this packet at the time it leaves X?

A The destination IP address is the IP address of R

B The destination IP address is the IP address of Y

C The destination MAC address is the MAC address of S

D The destination MAC address is the MAC address of Y

Consider sending an IP datagram of size 1420 bytes (including 20 bytes of IP header) from a sender to a receiver over a path of two links with a router between them. The first link (sender to router) has an MTU (Maximum Transmission Unit) size of 542 bytes, while the second link (router to receiver) has an MTU size of 360 bytes. The number of fragments that would be delivered at the receiver is ____

A 5

B 6

C 7

D 8

Consider the entries shown below in the forwarding table of an $\mathbb{P}$ router. Each entry consists of an IP prefix and the corresponding next hop router for packets whose destination IP address matches the prefix. The notation "/N" in a prefix indicates a subnet mask with the most significant N bits set to 1.

Prefix	*Next hop router*
10.1.1.0/24	*R1*
10.1.1.128/25	*R2*
10.1.1.64/26	*R3*
10.1.1.192/26	*R4*

This router forwards 20 packets each to 5 hosts. The IP addresses of the hosts are 10.1.1.16, 10.1.1.72, 10.1.1.132, 10.1.1.191, and 10.1.1.205. The number of packets forwarded via the next hop router *R2* is

A 40

B 20

C 10

D 5

Classless Inter-Domain Routing (CIDR):

- In CIDR subnet masks are denoted by /X. For example a subnet of 255.255.255.0 would be denoted by /24. To work a subnet mask in CIDR,
- With CIDR, we can create Variable Length Subnet Masks, leading to less wastage of IP addresses. It is not necessary that the divider between the network and the host portions is at an octet boundary. For example, in CIDR a subnet mask like 255.224.0.0 or 11111111.11100000.00000000.00000000 can exist.
- Subnetting

Sr. No.	Parameter	Classful Addressing	Classless Addressing
1.	**Basics**	In Classful addressing IP addresses are allocated according to the classes- A to E.	Classless addressing came to replace the classful addressing and to handle the issue of rapid exhaustion of IP addresses.
2.	**Practical**	It is less practical.	It is more practical.
3.	**Network ID and Host ID**	The changes in the Network ID and Host ID depend on the class.	There is no such restriction of class in classless addressing.
4.	**VLSM**	It does not support the Variable Length Subnet Mask (VLSM).	It supports the Variable Length Subnet Mask (VLSM).
5.	**Bandwidth**	Classful addressing requires more bandwidth. As a result, it becomes slower and more expensive as compared to classless addressing.	It requires less bandwidth. Thus, fast and less expensive as compared to classful addressing.
6.	**CIDR**	It does not support Classless Inter-Domain Routing (CIDR).	It supports Classless Inter-Domain Routing (CIDR).
7.	**Updates**	Regular or periodic updates	Triggered Updates
8.	**Troubleshooting and Problem detection**	Troubleshooting and problem detection are easy than classless addressing because of the division of network, host and subnet parts in the address.	It is not as easy compared to classful addressing.
9.	**Division of Address**	• Network • Host • Subnet	• Host • Subnet