1. Write two advantages and two disadvantages of Slotted ALOHA.
-Improved Efficiency: Introduces time slows allowing for a more organized and structured approach to data transmission.
-Predictable Collision Resolution: Collisions are more predictable and easier to detect and transmissions occur within specific time slots.
-Synchronization Required: Requires synchronizing all participating nodes to adhere to given time slots.
-Idle Slots: If a node has no data to send during its time slot, the slot remains idle. This is efficient in terms of utilizing available bandwidth.

2. What is the function of ARP in the link layer?
Maps IP addresses at network layer to the corresponding physical / MAC address at link layer. Attacks like ARP poisoning, telling routing that you are the destination MAC address for other clients.

3. Switches and routers both share some similarities but do completely different tasks. Explain three differences between these two devices in the link layer.
Switches forward based on MAC, routers use IP.
Switches operate with a single LAN, while routers connect different networks.
Switches operate within a single broadcast frame, while routers operate at the boundary of broadcast domains, not propagating traffic normally between different network segments.

4. Give two reasons why hubs are considered inferior to a switch or router?
Hubs just forward traffic to connected devices, if two devices try to send at the same time there will be a collision, data transmissions are also sent to all devices on the hub.
Routers / Switches provide segmentation of data collisions, lowering the chance of data collisions. Routers also have separate broadcast domains.

5. Link layer and transport layer share some common functionalities; however, they are different. What is the basic difference between them.
Link Layer provides reliable communication within a local network segment, built on the transport layer foundation.
Transport layer provides the functionality for end-to-end communication between devices.

6. Explain four services provided by the link layer.
Framing - breaks data into frames for physical transmission.
MAC addressing - assigns MAC addresses to each NIC.
Error Detection/Correction - detects errors that may have occurred in transmission.
Flow Control - manages rate of data transmission between devices.

7. Write the steps of the CSMA/CD algorithm implementation performed by Ethernet.
-Carried Sense :device checks communication line for idle/busy status.
-Frame Transmission: if idle, frame is transmitted.
-Collision Detection: If the transmitted signal is different from the received signal, transmission is halted.
-Jam Signal: When a collision is detected, all other devices on the network are pinged about the collision, so they can take needed action.
-Backoff/Retransmit: After sending Jam Signal, the device enters a random backoff period.
//After the backoff period has ended, This process restarts.
-Repeating until success: This process will continue to repeat until the frame is transmitted without collision.

8. In CSMA/CD, after the fifth collision, what is the probability that a node chooses

K = 4? The result K = 4 corresponds to a delay of how many seconds on a
10 Mbps Ethernet?
–1/32
51.2ms slot time * backoff time
backoff time of (2^K) - 1, so 0-15. We choose 7.
7*51.2 = 358.4ms

9. How big is the MAC address space? The IPv4 address space? The IPv6 address space?

MAC- 48bit IPv4-32bit IPv6-128bit

10. Why would the token-ring protocol be inefficient if a LAN had a very large perimeter?

Tokens must propagate the entire ring, with larger perimeters having severely reduced responsiveness and increased propagation delays.

11. Suppose the information content of a packet is the bit pattern 1110 0110 1001 1101 and an even parity scheme is being used. What would the value of the field containing the parity bits be for the case of a two-dimensional parity scheme? Your answer should be such that a minimum-length checksum field is used.
1 0 0 1 | 0

12. What is the difference between a datagram and a frame? Perform a CRC on datagram A = 10011001010 using a CRC generator 1011.
Datagram : Self-contained independent packet of data that carries enough information to be fully routed.
Frame : unit of data at data link layer, used to encapsulate packets or datagrams for transmission over something like an ethernet network.
checksum - 1010

13. To compute the Internet checksum, we add up the values at 16-bit quantities followed by a final one's complement at the end. Suppose you have the 8-bit unsigned binary ASCII representation of numbers from 1 to 10. These numbers are sequential. What will be your Internet checksum for this data?
1-9 are 6-bit… ill pad 00 left.., not doing 1-10.
0011 0001 = 1
0011 0010 = 2 -> 00110001 00110010
0011 0011 = 3 +
0011 0100 = 4 -> 00110011 00110100
= 01100100 01100110 1-comp => 10011011 10011001

14. Let's consider the operation of a learning switch in the context of a network in which 6 nodes labeled A through F are star connected into an Ethernet switch. Suppose that (i) B sends a frame to E, (ii) E replies with a frame to B, (iii) A sends a frame to B, (iv) B replies with a frame to A. The switch table is initially empty. Show the state of the switch table before and after each of these events. For each of these events, identify the link(s) on which the transmitted frame will be forwarded, and briefly justify your answers.

1. Port | MAC
   -Init
2. Port | MAC
   1 | B
   -Switch learns B is on port 1 from receive
   -Switch floods non-1 ports (like a hub) to reach E
3. Port | MAC
   1 | B
   2 | E
   -Switch learns E is on port 2 from receive
4. Port | MAC
   1 | B
   2 | E
   3 | A
   -Switch learns A on port 3 from receive
5. Port | MAC
   1 | B
   2 | E
   3 | A
   -Nothing learned

15. In this problem, you will put together much of what you have learned about Internet protocols. Suppose you walk into a room, connect to Ethernet, and want to download a Web page. What are all the protocol steps that take place, starting from powering on your PC to getting the Web page? Assume there is nothing in our DNS or browser caches when you power on your PC. Explicitly indicate in your steps how you obtain the IP and MAC addresses of a gateway router.

Turn on PC
Connect to Ethernet
DHCP Request - request to obtain IP address
DHCP lease offer - server / router replies with given IP address
DHCP Request and Ack - we Confirm IP and server/router acks
ARP request - broadcast ARP request to get MAC of router
ARP reply - gateway router replies with its mac, we update our ARP cache.
Default Gateway set - destination IPs outside LAN will be sent to this router.
Routing to Dest IP - Needing DNS resolution, we send a request to a local DNS server for the IP.
DNS resolution - DNS server replies with the resolved domain name, as an IP address
Frame Transmission to router - we encapsulate and send IP packets within ethernet frames which are sent to the gateway router using its MAC address, to be sent to external addresses.
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TCP Handshake - a 3-way handshake occurs between computer and web server to establish a connection.
HTTP Request - we send an HTTP/S request to retrieve the webpage
HTTP/S Response - we get the web page
TCP Termination - assuming TCP still, 4-way handshake in termination.
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Web Page displayed